WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 16, 450-553. Review Article ISSN 2277–7105

ANTIOXIDANT ACTIVITY OF *MORUS* (MULBERRY) SPECIES

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Article Received on 15 July 2026,
Article Revised on 04 August 2026,
Article Published on 16 August 2026,

https://doi.org/10.5281/zenodo.21914412

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How to cite this Article: Abdullatif Azab*. (2026). Antioxidant Activity of Morus (Mulberry) Species. World Journal of Pharmaceutical Research, 15(16), 450–553.

ABSTRACT

In our four previous review articles about the *Morus* (mulberry) plant genus, we presented the antidiabetic, brain-related, anti-inflammatory and anticancer properties-activities of its trees. In this article, antioxidant and related activities of this genus will be reviewed. Literature data possess hundreds of research articles about this crucial activity since biological oxidation is one of the fundamental processes in living organisms. This includes many undesirable oxidations that are opposed by antioxidants. All parts of *Morus* genus trees and shrubs contain natural products with wide range of antioxidant activities. Most of these compounds are polyphenols. The article presents the antioxidant activities alphabetically ordered by species. As usual, *Morus alba*, *Morus nigra* and in a less frequency, *Morus indica*, are the most studied and published. Interesting natural products structures will be presented. Previously published review articles that present antioxidant activity will be listed. Also, nanoparticles (NPs) that were prepared using *Morus* materials and have antioxidant activity, will also be listed.

KEYWORDS: Oxidative stress, Antioxidant, *Morus*, *Morus alba*, *Morus nigra*, *Morus indica*, Flavonoids, Anthocyanins, *In vitro* oxidation, *In vivo* oxidation.

Abbreviations: AAPH 2,2′-azobis(amidinopropane) dihydrochloride, ABTS 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), ahc and her/his colleagues, AChE acetylcholine esterase, βCBM β-Carotene bleaching method, BHA butylated hydroxyanisole, BuChE butyrylcholine esterase, CAT catalase, CUPRAC cupric reducing antioxidant capacity, DCM dichloromethane, DEE diethyl ether, DMSO dimethyl sulfoxide, DNJ 1-Deoxynojirimycin,

DPPH 2,2-Diphenyl-1-picrylhydrazyl, EO essential oil, EtOAc ethyl acetate, GABA γ-amino butyric acid, GCC general chemical composition, GC-MS gas chromatography mass spectrometry, GPx glutathione peroxidase, GSH glutathione, HDL high density lipoprotein, HPLC high performance liquid chromatography, LDH lactate dehydrogenase, LDL low density lipoprotein, LPS lipopolysaccharide, NPs nanoparticles, ORAC oxygen radical absorbance capacity, PBD phosphomolybdenum (assayPE petroleum ether, ROS reactive oxygen species, RPA Reducing Power Assay, SOD superoxide dismutase, STZ streptozotocin, TAC total antioxidant capacity, TBARS thiobarbituric acid reactive substances, TEAC Trolox equivalent antioxidant capacity, TFC total flavonoid content, TLC thin layer chromatography, TPC total phenolic content, TTC total tannins content.

1. SHORT INTRODUCTION: Oxidation is extremely vital process for living organism. Its major expression is the conversion of organic matter to available energy for the body, after reacting with oxygen. But these life-sustaining and hence desirable processes, are accompanied by undesirable reactions of oxidation. These are generally referred to reactive oxygen species, ROS. In one of our review articles, we have presented and discussed these ROS.[1] In that review article we presented the sources of ROS as well as the relationships between oxidative stress and major diseases. For the convenience of the current article readers, we combined both figures into **Figure 1**.

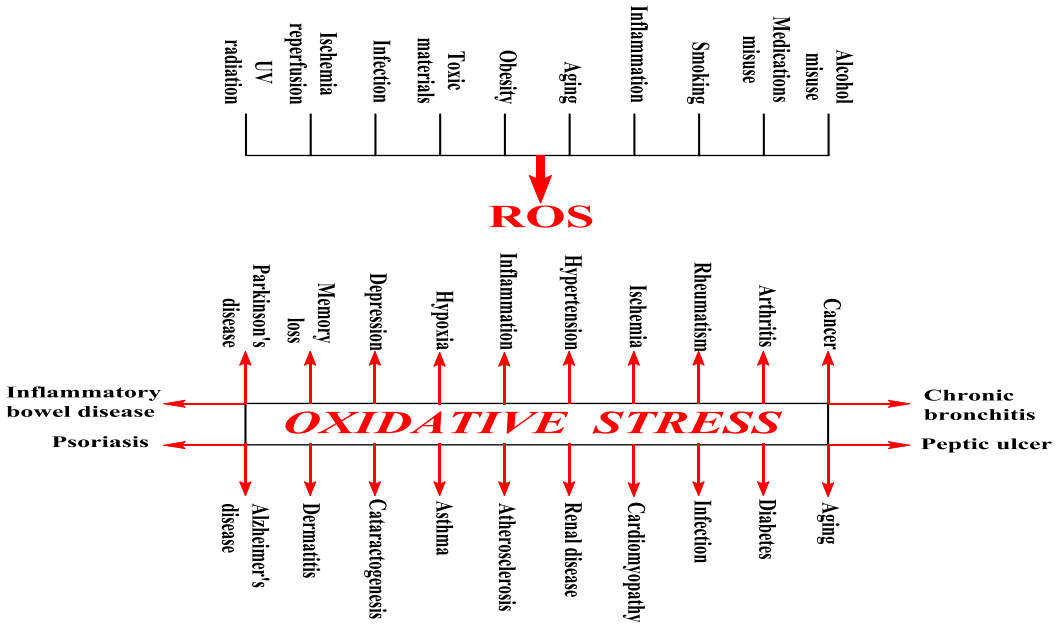


Figure 1: Sources of ROS and the relationships between oxidative stress and major diseases Based on this, the vital role of antioxidants is understood, whether these are naturally occurring in the human body, or supplied to it as nutrition.[2,3]

2. Selected Review Articles about *Morus* Species with Significant Antioxidant Activity

The number of review articles that were published so far about individual *Morus* species, about some of them or about them all, is very large. In this review article we will use the most relevant for our topic: antioxidant activity. These are presented in **Table 1**.

Table 1: Selected review articles about *Morus* species with clear antioxidant activity.

Author(s) Reference	Major Topic(s)	Pages Refs.[a,b]
M.S. Butt ahc[4]	*Morus alba*, mainly nutritional aspects, a medium size review with natural products structures	8 77
R. Singh ahc[5]	*Morus alba*, mainly traditional aspects, a medium size review with natural products structures	9 52
M.S. Zafar ahc[6]	*Morus alba*, mainly pharmacological aspects, a medium size review without natural products structures	9 76
B. Devi ahc[7]	*Morus alba*, small review, no structures of natural products, nice photos of the plant, antioxidant part is very small	5 36
H.P. Huang ahc[8]	*Morus alba*, medium size review, chemoprevention, mechanisms, detailed figures, brief antioxidant part	9 70
S. Yang ahc[9]	*Morus alba*, medium size review, detailed natural products structures, pharmacology, extensive antioxidant section	8 50
E.W. Chan ahc[10]	*Morus alba*, very detailed phytochemistry, pharmacology, figures and photos, clinical trials	14 92
A. Gryn-Rynko ahc[11]	*Morus alba*, leaves, medium size review, detailed pharmacology and phytochemistry, no structures	9 96
F. Hussain ahc[12]	*Morus alba* but mentions other species, mini review, no structures, antioxidant part is small, limited pharmacology	7 56
Q. Yuan, L. Zhao[13]	*Morus alba*, fucus on health benefits, listed phytochemical with few structures, extensive antioxidant presentation	12 130
O. Rebai ahc[14]	*Morus alba*, mini review, mainly neuroprotective and antioxidant activities, no phytochemistry or structures	6 48
S.B. Sanghi, S. Mushtaq[15]	*Morus alba*, some photos, very limited chemical composition, no structures pharmacology	10 39
H. Zhang ahc[16]	*Morus alba*, clear focus on health benefits, limited phytochemistry, no structures, very few figures	13 86
A.K. Pujari ahc[17]	*Morus alba*, very small review, good photos, lacks great deal of information	3 11
S. Shahana, A.P. Nikalje[18]	*Morus alba*, comprehensive phytochemistry and pharmacology	11 42
R.A. Kadam ahc[19]	*Morus alba*, very comprehensive	24 118
S. Bajpai ahc[20]	*Morus alba*, *Morus indica*, very short review, limited presentation of pharmacology, no compounds/structures	4 32
R. Ullah ahc[21]	Anthocyanins, outstanding, comprehensive, very helpful figures and illustrations, focuses of neuroprotection	32 216
R. Naik ahc[22]	Moracins A-Z, outstanding, comprehensive, structures, synthesis, pharmacology (example Moracin M, **Figure 3**)	15 79
X. Meng ahc[23]	Melatonin, outstanding, very comprehensive, sources,	64

	metabolites, bioactivities, biosynthesis (**Figure 3**)	340
A. Panek, M. Stompor[24]	Morusin, comprehensive, excellent, sources, synthesis, metabolites (detailed), extensive pharmacology (**Figure 3**)	18 85
R.K. Venkatesh, S. Chauhan[25]	*Morus*, history of research, good phytochemistry, very limited pharmacology	8 35
T. Nomura ahc[26]	*Morus alba*, isoprenylated flavonoids, biosynthesis, synthesis, extensive stereochemistry	17 60
S. Priya[27]	*Morus*, reasonable phytochemistry and pharmacology	9 97
D.A. Kostić ahc[28]	*Morus*, extensive history and botany, composition but no structures, very limited pharmacology	15 54
V.M. Miljković ahc[29]	*Morus*, good photos, botany, very limited phytochemistry and pharmacology, no structures	6 49
H.L. Ramesh ahc[30]	*Morus alba*, focus on antioxidant, other activities are also briefly mentioned, limited phytochemistry, no structures	24 119
Y. Yang ahc[31]	Polyphenols, very detailed, limited pharmacology	13 51
H. Wei ahc[32]	*Morus*, root bark, traditional uses, very comprehensive phytochemistry, pharmacology, excellent	36 124
D.S. Mahesh ahc[33]	*Morus*, limited composition, no structures, limited pharmacology, no figures, no photos	11 45
G.R. Aruna ahc[34]	*Morus*, very small article, history, no phytochemistry, no structures, limited pharmacology	4 39
T. Thaipitakwong ahc[35]	*Morus*, focuses on cardiometabolic risks, pharmacology, no phytochemistry, clinical and preclinical trials	10 62
N. Jan ahc[36]	*Morus*, very small article, phytochemical content and its quality, pharmacology, no structures	4 44
E.L. Rodrigues ahc[37]	*Morus*, metabolic dysfunctions, good photos, composition, no structures, toxicity, pharmacology	16 65
A.R. Memete ahc[38]	*Morus*, focus on food industry, compositions by plant parts, phytochemistry, no structures, pharmacology, patents	29 199
C. Tortora ahc[39]	*Morus*, synthesis, biosynthesis, pharmacology of Diels-Alder adducts, outstanding	48 119
J. Chen ahc[40]	*Morus*, focus on neuroprotective effects, illustrations, pharmacology and phytochemistry by plant part, excellent	24 116
A. Bhati ahc[41]	*Morus*, anti-inflammatory, antioxidant activities, phytochemistry, pharmacology, mechanisms, excellent	14 184
A. Budiman ahc[42]	*Morus nigra*, ethnomedicine, extended phytochemistry, no pharmacology	6 37
A. Khoerunnisa ahc[43]	*Morus nigra*, focus on antioxidant activity, limited other activities, no phytochemistry	12 59
S.H. Lim, C.I. Choi[44]	*Morus nigra*, nutritional importance, very extended pharmacology, no phytochemistry	18 131
Z. Zoofishan ahc[320]	*Morus nigra* roots, extensive phytochemistry, antioxidant and anticancer, special focus on Morusin	15 84

a) Refs., number of cited references.
b) In articles where cited references are not numbered, the presented numbers in this table are based on AI counting.

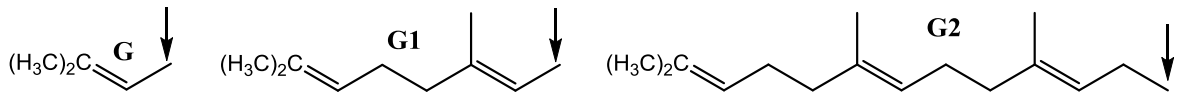


Figure 2: Structural groups used in this article and their symbols.

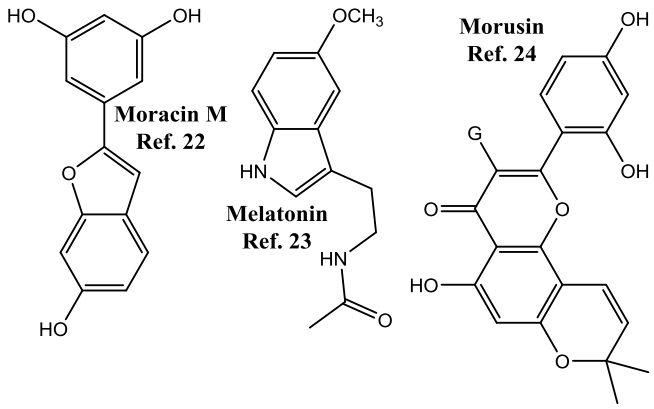


Figure 3: Structures of compounds mentioned in Table 1.

3. Published Studies of Antioxidant and Related Activities of *Morus* Species

The number of publications that reported antioxidant and related activities of *Morus* species is very large. *Morus alba* and *Morus nigra* are most published, each way more than any other species. For this review article, we considered only publications that reported these activities directly. These are presented after **Figure 4**. The very brief presentation include: *Morus* species, testing methods, results (in special cases), indication of proposed mechanism of action (if) and mentioning other reported activities. It is also important to emphasize that we will not mention *Morus* species that we found no literature about their antioxidant and related activities.

Figure 4: Young *Morus alba* tree growing in the author's home garden.

Morus alba

Leaves were separately extracted with *n*-hexane, EtOAc, acetone and methanol. The extracts were tested for inhibition of peroxidation of linoleic acid, with tocopherol and BHA as standards. Methanol extract was most active. Partial GCC is presented.[45]

Leaves were defatted with *n*-hexane and extracted with *n*-butanol, and the extract was analyzed yielding three new compounds (no names in this article, **Figure 5A**), along with six known compounds. All compounds were tested using LDL oxidation inhibition and DPPH methods. Quercetin was reference.[46]

Salt (NaC*l*) stress resulted in changes of antioxidant enzymes (like SOD) and oxidant-antioxidant biomarkers (like MDA).[47]

Twigs ethanolic extract was chromatographed affording 5,7-Dihydroxycoumarin 7-methyl ether, Cudraflavone B, Cudraflavone C and Oxyresveratrol (**Figure 5A**). These compounds were tested using superoxide scavenging and DPPH methods, resulting varying activities from very weak to significant. Three antioxidant compounds were used as references. Hepatoprotective activity is also reported.[48]

Root bark 70% aqueous ethanolic extract had inhibited (TBRAS method) lipid peroxidation in STZ-induced diabetic rats. The extract was chromatographed affording Morusin, Cyclomorusin, Neocyclomorusin, Moracin M and Kuwanon E (**Figure 5A**). Antidiabetic activity is the major topic of this publication.[49]

Leaves were extracted with aqueous ethanol solutions (0-100%, seven solutions). The extracts were combined (crude extract) and chromatographed yielding (after hydrolysis) Rutin, Isoquercitrin, Quercetin and Astragalin. The crude extract and the four compounds were tested using LDL oxidation inhibition method, resulting significant activities.[50]

Root bark 70% aqueous ethanolic extract was fractionized with several solvent yielding three fractions. These fractions were tested for LDL oxidation inhibition in cholesterol-fed rats. The fractions were analyzed affording Mulberroside A, Steppogenin-4'-*O*-β-glucoside, Albanol A and Albanol B (**Figure 5B**). Hypolipidemic activity is also reported.[51]

Leaves were separately extracted with ethanol and water. The extracts were supplemented to rats and TEAC of the animal's plasma was measured using ABTS method.[52]

Fruits were separately extracted with methanol and water, and the obtained anthocyanin-rich extracts inhibited LDL (human) oxidation. The extracts were analyzed (TLC) and the major components that were detected were: Cyanidin-3-glucoside, Cyanidin-3-rutinoside, Pelargonidin-3-glucoside and Pelargonidin-3-rutinoside. The aglycons Cyanidin and Pelargonidin are shown **Figure 5B**.[53]

Aqueous extracts of three phenotypes were analyzed for TPC and tested for antioxidant activity using βCBM method. GCCs are also published.[54]

Branches, fruits, leaves and roots were separately extracted with methanol, and the four resulting extracts were partitioned with *n*-butanol and EtOAc. The extracts and fractions were analyzed for TPC, organic acids content and tested with DPPH method. Roots extract was most potent. Leaves extract was also tested after fermentations. Anticancer activity is presented.[55]

Leaves aqueous extract was tested using lipid peroxidation method. In this study, leaves aqueous extract of *Rosmarinus officinalis* was also tested.[56]

Leaves fresh and fermented aqueous extracts were tested using DPPH and SOD activation methods. Anticancer activity is also published.[57]

Filtered fruit juice was tested using DPPH and cupric sulfate reducing method. Tyrosinase inhibition activity is also reported.[58]

Activity of the antioxidant enzymes catalase and guaiacol peroxidase from fresh fruit juice of varieties and hybrids was tested.[59]

Leaves were defatted with PE and extracted with methanol. The resulting extract was tested using lipid peroxidation and SOD activation methods. Protective effect against Haloperidol-induced orofacial dyskinesia is also published.[60]

Freeze dried fruits were supplemented to high fat fed rats. The antioxidant effect was tested with TBRAS method and activity of antioxidant enzymes. The extract was analyzed for dietary fibres, trace elements and fatty acids composition. Hypolipidemic activity is also reported.[61]

Fruits 70% aqueous ethanolic extract was active against 6-Hydroxydopamine-induced

accumulation of reactive oxygen species in SH-SY5Y cells. Antialzheimer effect (in rats) is the main topic of this article.[62]

Leaves 70% aqueous ethanolic extract improved GSH level and inhibited lipid peroxidation (TBRAS) in CCl_4-induced hepatotoxicity in isolated rat hepatocytes. Hepatoprotective effect (other parameters) is also reported.[63]

Leaves were successively extracted with water and methanol, and the combined extracts improved the levels of antioxidant biomarkers (CAT, GSH, SOD). in CCl_4-induced hepatotoxicity in rats. Silymarin was reference in this study.[64]

Leaves were extracted in autoclave conditions (121 °C, 15 minutes) and the flavonol content was determined by HPLC. The major compounds were Quercetin-3-*β*-D-glucose, Quercetin-3-O-glucose-6''-acetate, Rutin and quercetin (aglycon). All compounds showed high activity in ORAC assay.[65]

Using combined far-infrared radiation with hot-air convection for leaves drying improved TPC and increased antioxidant activity (DPPH, FRAP). The phenolic acids compositions were determined in fresh leaves, dried leaves using this method and commercial dry leaves. For example, the concentration of Ferulic acid (mg/g, **Figure 5B)** 6.93, 199.1 and 15.61, respectively.[66]

Roots and twigs were separately extracted with ethanol. The extracts were analyzed for TFC and TPC and tested using DPPH (twigs extract was more active), FRAP, superoxide scavenging, liposome oxidation and Fe^{+2} chelating methods. According to a table (1) in this publication, Maclurin (**Figure 5B**) was the major component of both extracts. Interestingly, this is not the case according to the chromatogram shown before this table. Antityrosinase activity is also reported.[67]

Fruits pomace ethanolic extract was tested using DPPH, superoxide scavenging and βCBM methods. The extract was chromatographed and the major components were Cyanidin-3-glucoside and Cyanidin-3-rutinoside.[68]

Tea of fermented leaves were compared to tea of *Camellia sinensis*. Higher antioxidant compounds concentrations were found, in addition to stronger antioxidant activity (FRAP, DPPH). Several other compounds with nutritional importance like GABA were also found in

higher concentrations.[69]

Leaves were dried using microwave, oven and freeze-drying, and each dry matter was extracted with 50% aqueous methanol. Each one of the three extracts was analyzed for TPC and tested using ascorbic acid equivalent capacity, FRAP, DPPH and potassium ferricyanide assays. Microwave drying was most efficient.[70]

Fruits, leaves and stems were separately extracted with boiling water and 80% aqueous ethanol, and the six resulting extracts were analyzed for TFC and TPC. They were tested using DPPH method. Leaves extracts were most potent. Antimicrobial activity is reported.[71]

Bark methanolic extract was fractionized with several solvents and chromatographed affording three compounds (**Figure 5B**): 5,5'-Diprenyl-7,3',4'-trihydroxy flavanone, 5-Prenyl-3,7,3',4'-tetrahydroxy flavanonol and Quercetin-3-*O*-α-L-rhamnoside. The crude extract and the isolated compounds were tested using DPPH method. Anti-sickling, cytotoxic and molecular docking for enzyme inhibition, are also reported.[72]

Fruits methanolic extract was fractionized with five solvents and chromatographed (TLC) yielding Morin (**Figure 5B**). This compound and the fractions were analyzed for TPC and tested using ABTS and DPPH methods. Antibacterial activity is reported.[73]

Leaves of six cultivars were harvested in seven different times of the year and extracted with 70% aqueous ethanol (pH=4). The extracts were analyzed for TPC and tested using FRAP, hydroxyl radical scavenging activity and superoxide radical scavenging activity assays. The extracts were also analyzed for four single antioxidant compounds: Chlorogenic acid, Benzoic acid, Rutin and Astragalin. Leaves of a cultivar symbolized with Kq10 harvested in May had the highest contents and activities.[74]

Fruits methanolic extract was tested with DPPH method as a standard. The protective effect against oxidative stress was tested by supplementation of the fruits powder to γ-irradiated rats. Effect was measured using twelve biomarkers.[75]

Leaves and stems aqueous extracts were subjected to hydrodistillation with DCM. The resulting distillates were analyzed (gas chromatography) for volatiles, and the major components were Dihydroctinidiolide (**Figure 5B**) and Hexanoic acid, respectively. The crude distillate and the isolated compound were tested using MDA assay. *Camellia sinensis*

and *Cudrania tricuspidata* were also investigated in this research.[76]

Leaves methanolic extract was supplemented to rats resulting decrease of lipid peroxidation (TBRAS) and increase of the activities of SOD, CAT, GPx and GSH. Cardioprotective activity is the major topic of this publication.[77]

Fruits ethanolic extract was analyzed for TFC, TPC, total anthocyanin contents, and was tested using FRAP and DPPH methods. Blueberry fruits were used as a standard and cognitive protection activities are the major topic of this publication.[78]

Root bark 95% aqueous ethanolic extract was partitioned with EtOAc and water, and the organic fraction was chromatographed affording Morusalbanol A (**Figure 5B**). This compound had protective activity against hydrogen peroxide-induced cell damage.[79]

Branches, fruits, leaves and roots were separately extracted with water. The extracts were analyzed for partial GCCs, organic acids and tested using DPPH method. Tyrosinase inhibition (major topic) and anticancer activities are reported.[80]

Fruits 80% aqueous ethanolic extract was analyzed for nutritional value, minerals, TFC, TPC, total anthocyanin content and fatty acids composition. It was tested using DPPH and hydroxyl radical scavenging methods. This is a comparative study of four species and eight cultivars.[81]

Fruits, leaves, root bark and stem bark, were separately extracted with methanol. The extracts were analyzed for TFC, TPC and total anthocyanin content. They were also tested using DPPH, FRAP and hydroxyl radical scavenging methods.[82]

Leaves (Polish variety) aqueous extract was analyzed for partial GCC, TPC, major flavonols, phenolic acids, monosaccharides and ascorbic acid content. It was tested using ABTS, DPPH and ferrous ion chelating methods.[83]

Fruits 70% polyphenols-rich aqueous ethanolic extract was successively fractionized with water, *n*-hexane, $CHCl_3$, EtOAc and *n*-butanol. The crude extract and the fractions were analyzed for TFC and TPC. They were also tested using DPPH and Superoxide anion radical scavenging methods. The EtOAc fraction was used to treat STZ-induced diabetic mice, and its effect of antioxidant enzymes (CAT, GHS-x, SOD) was recorded. This fraction was

analyzed for chemical composition affording 21 known phenolics. Antidiabetic activity is reported.[84]

Stem bark methanolic extract was chromatographed yielding Albosteroid (**Figure 5B**), in addition to four previously known compounds. The new compound was tested against ethanol-induced ulcer in rats, and its effect of antioxidant enzymes (CAT, GHS-x, SOD) was recorded. Antiulcer is the major topic of this publication (That includes mistaken captions of figure 1 and figure2).[85]

Commercial Muesli that contained fruits of this species was analyzed for nutritional composition and tested with ABTS and DPPH methods.[86]

Leaves were collected in ten different locations were extracted with methanol, and the resulting extracts were analyzed for TFC, TPC and tested using DPPH method. The extracts were also chromatographed for major phenolics: Astragalin, Isoquercitrin and Rutin.[87]

Leaves were separately extracted with ethanol and water, and the total antioxidant status of both extracts was tested: ethanolic extract was more active. The ethanolic extract was analyzed (GC-MS) resulting four major compounds: 9,12,15-Octadecatrienoic acid and its ethyl ester, Linolenic acid ethyl ester and Gibberellic acid. Antimicrobial activity is also reported.[88]

Leaves 70% aqueous methanolic extract was used to treat *Schistosoma mansoni* infection in mice. The antioxidant activity was measured using three biomarkers: GSH, MDA and nitrite/nitrate ratio.[89]

Fruits were separately extracted with 50% aqueous acetone, 50% aqueous ethanol and 50% aqueous methanol. Each extract was analyzed for TFC, TPC, total anthocyanin content and mineral content (including heavy metals). The extracts were tested using DPPH method. Antimicrobial activity is reported.[90]

Fruits 70% aqueous ethanolic extract was partitioned with several solvents. The crude extract and its fractions were tested using DPPH, TBRAS and H_2O_2-induced ROS in pancreatic β-cells. DNA protection is reported.[91]

Branch bark 30% aqueous ethanolic extract was analyzed for TFC, TPC and total sugar

content. It was tested using DPPH method. Other reported activities were inhibition of: α-glucosidase, tyrosinase and sucrase.[92]

Leaves 50% aqueous ethanolic extract attenuated testosterone production depletion in STZ-induced diabetic male rats. It also reduced oxidative stress, where effect was measured with oxidant-antioxidant biomarkers.[93]

Leaves flavonoid-rich 65% aqueous methanolic extract was fractionized with several solvents including EtOAc. This fraction was used to treat gastroesophageal reflux disease (GERD) in rats. The antioxidant effect was measured using the following biomarkers: lipid peroxidation, CAT, SOD and GSH. Analysis of the DEE fraction of the extract afforded previously known polyphenols, with Quercetin as a major component.[94]

Leaves aqueous extract was analyzed for TFC and TPC and was tested using DPPH method. Antiviral activity is reported.[95]

Fruits of *P. granatum*, *F. carica*, *M. alba*, and *G. biloba* 70% aqueous ethanolic extracts were used to prepare topical formulation that was tested using DPPH, H_2O_2 scavenging and super oxide anion scavenging methods. The formulation was also tested for collagenase inhibition (*in vitro*) and anti-wrinkle in humans.[96]

Leaves 70% aqueous methanolic extract was supplied to male mice and the activities of GSH and MDA were measured. Effect was tested in kidney, testes, spleen and intestine.[97]

Roots 80% aqueous ethanolic extract was tested using DPPH method. In this study another 43 plants were investigated, and the tyrosinase inhibition is reported.[98]

Fruits from various locations (Serbia) were extracted with slightly acidic methanol affording flavonoid-rich extracts. These were analyzed for TPC and total anthocyanin content, and tested using DPPH, Fe^{+2} chelating, reducing power assay and super oxide anion scavenging methods. HPLC analysis of the extracts afforded 16 known phenolics including Aesculin and Gentisic acid (**Figure 5C**).[99]

Fruits were successively extracted with pure and 70% aqueous ethanol. The combined extracts were partitioned with several solvents and chromatographed yielding seven compounds: Artoindonesianin O, Isobavachalcone, Morachalcone A (**Figure 5C**), Quercetin,

Astragalin, Isoquercetin and Rutin. All compounds were tested for Glutamate-induced oxidative injury in HT22 cells, where Artoindonesianin O and Morachalcone A were most active.[100]

Fruits 70% aqueous ethanolic extract was analyzed for TFC and tested using the following methods: DPPH, Fe^{+2} chelating, reducing power [$K_3Fe(CN)_6$] and TBRAS.[101]

Stem bark methanolic extract was analyzed for TFC, TPC and total anthocyanin content. It was tested using TAC, reducing power [$K_3Fe(CN)_6$], DPPH, hydroxyl radical scavenging and lipid peroxidation methods. Anticancer activity is also reported.[102]

Leaves of C_{763} variety were separately extracted with ethanol and methanol. The extracts were tested using DPPH and FRAP methods. Antidiabetic activity is reported.[103]

Leaves were separately extracted with 65% aqueous acetone and 65% aqueous ethanol, after extraction solvent and temperature optimization. The extracts were supplemented to diabetic rats and supplementation effect blood plasma of diabetic rats, was tested with FRAP and TBRAS methods. The effect on element status (Cu, Fe, Zn) was also determined.[104]

Roots of twelve varieties and hybrids were separately extracted with *n*-hexane, ethanol and water. The resulting extracts were analyzed for TFC and TPC, and tested using ABTS, DPPH and PBD methods.[105]

Leaves aqueous extract alleviated oxidative stress (tested using lipid peroxidation and GSH level) in liver of rats treated with *N*-Nitrosodiethylamine. Anticancer activity is the major topic of this publication.[106]

Leaves were separately extracted with 50%, 60%, 70%, and 95% aqueous ethanol. The 60% extract had the highest TPC, and it was analyzed for partial chemical composition, resulting known phenolics. Then it was tested using DPPH and FRAP methods. The extracts were microencapsulated.[107]

Leaves 70% aqueous methanolic extract was analyzed for TPC and partial chemical composition, affording known phenolics. The crude extract was fractionized with several solvents. The crude extract, fractions and some of the isolated phenolics were tested using DPPH and FRAP methods. Antimicrobial activity is also reported.[108]

Leaves aqueous extract was analyzed for TPC, GCC and chemical composition, resulting known compounds. The extract was tested using ABTS and DPPH methods. It was also used for preparing yogurt, and the nutritional and probiotic properties were determined.[109]

Stem bark was analyzed for TFC, TPC and oxyresveratrol content, which was isolated from the extract. The extract and oxyresveratrol were tested using DPPH, hydroxyl radical scavenging, superoxide radical scavenging and nitric oxide scavenging. In addition, oxyresveratrol was tested using FRAP method.[110]

This study investigated the effect of extraction solvent on TFC, TPC, total monomeric anthocyanins, and the antioxidant activity using DPPH method. Fruits were extracted with several polar solvents which were combinations of ethanol, water and acetic acid. The extracts were also tested for antiproliferative activity.[111]

Leaves ethanolic extract was tested using DPPH method. Antifungal and cytotoxic activities are also reported.[112]

Leaves were sequentially extracted with *n*-hexane, PE, EtOAc, methanol and water. Extracts were analyzed for TPC and tested using DPPH and hydroxyl radical scavenging methods. Methanolic extract was most active. Anti-clastogenic activity is reported.[113]

Leaves 65% aqueous ethanolic extract was analyzed for TFC, TPC and DNJ (**Figure 5C**) content. It was also analyzed for phenolics composition resulting known compounds. The extract was tested using ABTS and DPPH methods. The extract was supplemented to high fat-fed rats, and their blood plasma was tested using FRAP and TBRAS methods, showing ameliorating effect.[114]

Stem bark was defatted with PE and extracted with 70% aqueous ethanol. The extract was supplied to STZ-induced diabetic rats, and the antioxidant effect was measured using GSH, MDA and SOD. Antidiabetic activity is reported.[115]

Leaves 70% aqueous ethanolic extract was washed with chloroform/methanol/1:1 affording four polysaccharides (Arabinose and Galactose where major monosaccharides). These polysaccharides were tested using ABTS, DPPH, Fe^{+2} chelating, hydroxyl radical scavenging and reducing power methods. Thermal properties of the polysaccharides are reported.[116]

Six extracts were prepared from roots: aqueous ethanol 50, 70, 96% and aqueous methanol 60, 85 100%. These extracts were analyzed (HPLC) for oxyresveratrol (100% methanolic extract was highest) and tested using DPPH method. Antityrosinase activity is also reported.[117]

Combination of β-Glucan (polysaccharide) and commercial leaves extracts (aqueous and ethanolic) was supplemented to high fat-fed mice, resulting positive synergistic effect on liver ROS. Other effects on metabolic disorders are reported.[118]

Leaves 70% aqueous ethanolic extract was analyzed for TFC and TPC and tested using DPPH method. It was supplemented to rats with *N*-Nitrosodiethylamine-induced hepatotoxicity. The *in vivo* effect was measured using TBRAS method and liver enzymes (GSH, SOD, CAT).[119]

Leaves aqueous extract was supplemented to STZ-induced diabetic rats showing positive effect on TAC blood plasma. Antidiabetic activity is the major topic of this publication.[120]

Two test groups of high fat-fed mice were separately fed with leaves and 70% aqueous ethanolic extract. In both tests the results showed positive effect on TAC, MDA and SOD. Hypoglycemic and hypolipidemic effects are the major topics of this publication.[121]

Leaves 70% aqueous acetone extract had neuroprotective effect against glyphosate-induced toxicity in rats. Effect was measured with lactate dehydrogenase, CAT, peroxidase and SOD levels. Other biomarkers are also reported.[122]

Stem bark methanolic extract was chromatographed yielding a novel flavone, Morusflavone [5,7,4'-trihydroxy-8-(γ,γ-dimethylallyl)-2',3'-(10'-hydroxy-9',10'-dimethyl-cyclohex-8-enyl)-flavone, **Figure 5C**]. The compound was active against oxidative stress in human epilepsy model, pentylenetetrazole-induced kindling in rats.[123]

Leaves of four cultivars were extracted with water, and the extracts were analyzed affording oligopeptides. These were tested using ABTS, DPPH, NO scavenging, Fe^{+2} chelating, lipid peroxidation and reducing power methods. Antidiabetic activity is also reported.[124]

Leaves 75% aqueous ethanolic extract (selected after optimized solvent study) was analyzed for TFC, TPC and TTC. It was tested using DPPH and βCBM. Antidiabetic activity is also

reported. This study included leaves of other six plants.[125]

Commercial leaves powder was extracted with 50% aqueous methanol, and the resulting extract was defatted with *n*-hexane, then analyzed yielding five phenolics: Gastrodin (**Figure 5C**), 4-*O*-Caffeoylquinic acid, 5-*O*-Caffeoylquinic acid, Isoquercetin and Rutin. All compounds were tested using DPPH method, resulting only Gastrodin having relatively low activity.[126]

Commercial flavonoids-rich leaves extract combined with *Candida tropicalis* were fed to dairy calves challenged with *Escherichia coli*. Results showed positive effects on several parameters, including antioxidant biomarkers (GSH, MDA, SOD).[127]

GCCs and nutritional parameters (very detailed) of six genotypes leaves were determined in this study, along with antioxidant activity tested using DPPH method.[128]

Leaves (*Mori Folium*) aqueous extract was supplied to diabetic rats (High glucose diet and STZ-induced). Results showed bone protective effect through two mechanisms of action, including redox homeostasis.[129]

A novel method for maximizing the phenolics (hydrolysed aglycones) content of leaves ultrasound-assisted hydroalcoholic extraction: ethanol-HCl-water (7/2/1, v/v/v) solution at 75°C by ultrasound (40 kHz) for 60 min. The resulting extracts were tested using DPPH method.[130]

AmLexin, a blend of commercial extracts of heartwood of *Acacia catechu* and root bark of *Morus alba*, was supplied to healthy runners. The effect was tested using several parameters including blood plasma oxidative stress after half marathon run.[131]

Leaves powder was supplemented to pigs resulting positive effect on several parameters, including SOD levels in blood serum.[132]

Leaves extraction solvent was optimized for high flavonoids content, and they were extracted with 40% aqueous ethanol, yielding four significant extracts. These were tested using ABTS, DPPH and reducing power methods. Antimicrobial and α-amylase inhibition activities are also reported,[133]

Stems ethanolic extract was analyzed for partial GCC, TFC, TPC and tested using ABTS

method. Anticancer activity is reported.[134]

Leaves were separately extracted with water and 80% aqueous methanol. They were tested in PC-12 cells using CAT, GSH and SOD biomarkers. Antiaging activity is also reported.[135]

Commercial leaves samples were separately extracted with water and aqueous methanol, and the extracts were analyzed for TFC, TPC, total phenolic acids content and ascorbic acid content. They were tested using DPPH and FRAP methods. HPLC analysis of the extracts resulted clear differences in phenolic compositions, where aqueous methanolic extract contained more compounds. In both cases, extracts contained known compounds. AChE inhibition activity is also reported.[136]

Fruits were extracted with 90% aqueous ethanol, then with water, and the resulting matter was chromatographed yielding a novel polysaccharide, composed of monosaccharides: Arabinose, Galactose, Glucose and Rhamnose. The zinc derivative of the polysaccharide was prepared, and both were tested using ORAC and peroxyl radical scavenging (*in vitro*), and HepG2 cells. Hypoglycemic activity is reported.[137]

Fruits were used to prepare anthocyanin-rich jelly (up to 26% w/w), and the TPC, total anthocyanin content, nutritional values and partial GCC were determined. The jelly was tested with DPPH, FRAP and ORAC methods.[138]

Leaves extraction was optimized (temperature and solvent) and 70% aqueous methanol was used. This extract was analyzed for DNJ content, TPC, and was tested using ABTS and DPPH methods. The extract was also analyzed for Quercetin and Kaempferol contents.[139]

Fruits aqueous extract combined with amino acids isolated (HPLC) from dried silkworms (*Bombys mori*) had alleviating effect in HepG2 cells (TBRAS method) and in high fat-fed rats (GSH, MDA, SOD biomarkers). The extract was analyzed for TFC, TPC and contents of Rutin, Hydroxybenzoic acid and Cyanidin-3-glucoside. The hydrolysate of silkworms was analyzed for Glycine, Alanine, Serine, Valine and Aspartate. Anti-inflammatory and antidiabetic activities are reported.[140]

Leaves 70% aqueous methanolic extract had ameliorating effect on Gentamicin-induced nephrotoxicity in rats. Effect was measured using several parameters including serum GSH and MDA levels.[141]

Leaves were successively extracted with *n*-hexane, PE, EtOAc, methanol and water. The extracts had nephroprotective and cognitive enhancing activities: H_2O_2-induced toxicity in U87MG cells and aluminum fluoride-induced toxicity in rats. Effects were measured with several parameters including CAT, GSH, SOD, lipid peroxidation and AChE levels.[142]

Seeds were analyzed for GCC, trace elements, nutritional values and were cold pressed for EO. This was analyzed for TPC, fatty acids content, tocopherols content (four), sterols and 4-Anisidine (**Figure 5C**). EO was tested using DPPH method.[143]

Leaves 70% aqueous methanolic extract had protective activity in mice brains infected with *Schistosoma mansoni*. The effect was measured using several parameters including nitrite/nitrate ratio, MDA, CAT, GSH and using TAC method.[144]

Leaves were subjected to a new extraction process with water, and the resulting extract was analyzed for GCC, TFC, TPC, DNJ content fatty acids composition, amino acids composition chlorophylls a and b, and phenolics (acids and flavonoids) content. It was tested using ABTS, DPPH, FRAP and Fe^{+2} chelating methods.[145]

Leaves were separately extracted with 80% aqueous ethanol and water, and the hydroethanolic extract was partitioned with chloroform and EtOAc. Additionally, it was analyzed for active phenolics affording Isoquercetin and Rutin. The hydroethanolic extract and its fractions were tested using DPPH. Anticancer activity is the main topic of this publication.[146]

Leaves of four genotypes were separately extracted with 50% aqueous ethanol, and the resulting extracts were tested using DPPH method. It was also tested against H_2O_2-induced oxidative stress in *Caenorhabditis elegans*. The extract was analyzed for chemical composition resulting the identification of 53 compounds. Anti-inflammatory and antiobesity activities are the major topic of this article.[147]

Root bark (*Mori Cortex Radicis*) was separately extracted with 70% aqueous ethanol and water, and they were analyzed for TFC and TPC. They were tested using ABTS, DPPH, and against Ethyl bromide-induced oxidative stress damages in DNA. Anti-inflammatory and anticancer activities are reported.[148]

Fruits of 27 cultivars were extracted with 70% aqueous ethanol, and the resulting extracts

were analyzed for TPC, Anthocyanins and Anthocyanidins contents. HPLC analysis resulted four major active phenolics Quercetin, Cyanidin, Cyanidin 3-glucoside and Cyanidin 3-rutinoside. The extracts and the single compounds were tested with DPPH, FRAP and ORAC methods. Antialzheimer (enzyme inhibition) activity is reported.[149]

Mixing fruits and leaves with honey enhanced TPC and antioxidant activity (DPPH, FRAP). Extraction was made only for chromatographic analysis which resulted 23 known phenolics. Inhibition of carbohydrate hydrolyzing enzymes is also reported.[150]

Leaves extraction with 95% aqueous ethanol was improved by using pulsed electric field. Extract was analyzed for TPC, DNJ content, and tested with ABTS, DPPH and FRAP methods. Anti-tyrosinase and anti-hyaluronidase activities are reported.[151]

Fruits (two cultivars) were separately extracted with water and 95% aqueous ethanol. The extracts were analyzed for TFC, TPC and total anthocyanin content, and were tested using ABTS, DPPH and FRAP methods. Antibacterial activity is reported.[152]

Fruits 70% aqueous ethanolic extract was fractionized with *n*-hexane, DCM, EtOAc, *n*-butanol and water. The crude extract and fractions were analyzed for TFC, TPC and tested using ABTS, DPPH and FRAP methods. They were also tested using CAT, GPx and SOD levels in LPS-treated RAW 264.7 macrophages. In this test, Quercetin, isolated from the EtOAc fraction was also tested. All fractions (except aqueous) were partially analyzed (HPLC) for active compounds resulting the identification of twenty known natural products including (**Figure 5C**) Ar-Turmerone (*n*-hexane), Odisolane (DCM), Morrole A (EtOAc) and Butyl L-pyroglutamate (*n*-butanol). Anti-inflammatory activity is reported.[153]

Root bark ameliorated antioxidant enzymes (CAT and SOD) levels in Cyclophosphamide-induced somatic and germinal cell damage in male rats. Other health parameters of the animals are also reported, especially sperm related.[154]

Branches, fruits and roots were separately extracted 80% aqueous ethanol, and the extracts were chromatographed to isolate Resveratrol and Polydatin (**Figure 5C**). These compounds were tested *in vitro* using ABTS, DPPH and ORAC methods. They were also tested against AAPH-induced oxidative damage in HepG2 cells, where effect was measured using five biomarkers: CAT, GSH, LDH, MDA and SOD. A mechanism of action is proposed.[155]

Root bark was separately extracted with *n*-hexane, DCM, acetone, ethanol, methanol and water. The resulting extracts were analyzed for TFC and TPC, and were tested with ABTS, DPPH, FRAP and super oxide scavenging methods. The methanolic extract was chromatographed where the amounts of six active compounds were determined: Umbelliferone, Kuwanon G (**Figure 5C**), in addition to Morin, Morusin, Oxyresveratrol and Kuwanon H. The six compounds were also tested using the same four methods. The extracts and the compounds were tested for inhibition of α-amylase, tyrosinase and anti-inflammatory activities.[156]

Donated flavonoids-rich leaf extract was supplemented to high-carbohydrate-induced liver oxidative stress in *Monopterus albus*, resulting positive effect on several parameters including CAT, GSH, GPx and SOD. Anti-inflammatory activity and effect on intestinal microbiota are also reported.[157]

Gamma-irradiated leaves methanolic extract was analyzed for TFC, TPC, nutritional values and for singles phenolics (9 known). The extract was tested using DPPH method. Anticancer and antibacterial activities are reported. Leaves and seeds of Grape tree are also reported.[158]

Leaves aqueous extract and its component Neochlorogenic acid (commercial, **Figure 5C**) alleviated Glucolipotoxicity-induced oxidative stress rat aortic vascular smooth muscle cells. Effect was evaluated using several parameters including SOD. A mechanism of action is proposed.[159]

Fruits acetonitrile extract separately and in combination with Rutin protected ethanol-damaged GES-1 cells. Effect was tested using several parameters including GSH, MDA and SOD. The extract was analyzed for GCC and detailed chemical composition resulting the identification of 108 compounds, including Chlorogenic acid and Magnoflorine (**Figure 5D**). A mechanism of action is proposed.[160]

Fruits of 13 Chinese cultivars were extracted with 70% aqueous ethanol, and the extracts were analyzed for GCC, TFC and TPC. The extracts were tested using DPPH, FRAP and hydroxyl scavenging methods. They were also analyzed for three major phenolics content: Cyanidin-3-*O*-Glucoside, Pelargonidin-3-*O*-Rutinoside and Cyanidin-3-*O*-Rutinoside.[161]

Leaves were extracted using ultrasonic-assisted enzymatic extraction and 70% ethanol (pH=5). The resulting extract was hydrolysed and analyzed 39 known phenolics including

Hesperidin (**Figure 5D**), with highest concentration. The extract was tested using ABTS, DPPH, hydroxyl radical scavenging and superoxide anion radical scavenging. It was also tested against AAPH-induced sheep erythrocytes' oxidative stress by measurement of CAT, GSH, MDA and SOD biomarkers.[162]

Seeds of six varieties were extracted with 80% aqueous methanol, and the resulting extracts were analyzed for TPC. They were also analyzed for bound (11) and free (28) phenolics and were tested using DPPH and FRAP methods. The relationship between TPC and antioxidant capacity is reported.[163]

Ultrasonic-assisted aqueous leaves extracts of three varieties were prepared and were analyzed for TFC and TPC. They were tested with DPPH method. In addition, the extracts were analyzed for Isoquercetin and Rutin Contents.[164]

Leaves green teas of three cultivars were analysed for TFC and TPC, and were tested using ABTS, DPPH and FRAP methods. The teas were chromatographed for major seven phenolics (Gallic-, Caffeic-, Gentisic-, Protocatechuic-, Chlorogenic acid, Rutin and Myricetin) contents. The impact of processing the plant material on Melatonin and Tryptophan contents is presented. The AChE inhibition activity is also reported.[165]

Leaves were separately extracted with water, 80% aqueous ethanol and successively with 80% ethanol and water (total of three extracts). These extracts were analyzed for phenolic compounds (11), DNJ and crude polysaccharides. The extracts alleviated oxidative stress in acute liver injury in rats (CAT, GSH, MDA and SOD levels were measured). Anti-inflammatory activity is reported.[166]

Leaf powder was supplemented to growing pigs and had positive effect on several growth parameters, including immune-antioxidant status. Effect was measured mainly with MDA levels in blood serum.[167]

Leaves 70% aqueous ethanolic extract was separately supplemented or in combination with Flaxseed extract to ovariectomized female rats, resulting positive effect on several parameters. The extract was analyzed for TPC and tested with βCBM method.[168]

Leaves methanolic extracts of four varieties were analyzed for GCC, TFC, TPC, mineral content and ascorbic acid content. The extracts were tested using DPPH and FRAP methods.

The extracts were chromatographed resulting the identification of 19 known phenolics including Sanggenon T (**Figure 5D**). Antidiabetic activity is reported.[169]

Leaves of two cultivars were extracted with 95% aqueous ethanol, and the resulting extracts were analyzed for TFC, TPC and resveratrol and oxyresveratrol contents. The extracts were tested using ABTS, DPPH and FRAP methods. The anti-inflammatory activity of the crude extracts and the single isolated compounds in LPS-stimulated RAW 264.7 macrophage cells, is reported.[170]

Leaves were harvested in various maturity periods and stored for different time periods, then extracted with 70% aqueous methanol. The extracts were tested using ABTS, DPPH and FRAP methods. Both variables (maturity stage and storage time) had clear effect on antioxidant activity and the metabolite composition of the extracts.[171]

Follow up of the work cited in reference 167. The tested biomarkers were CAT, GSH, MDA and SOD. In addition, TAC method was used to test the antioxidant activity of blood and liver serum.[172]

Fruits, leaves, shoots and roots were separately extracted with 80% aqueous methanol. The extracts were analyzed for TFC, TPC and contents of Ascorbic acid, Dehydroascorbic acid, Chlorophyll a, Chlorophyll b, Anthocyanins and Carotenoids. The extracts were tested using DPPH, FRAP, hydroxyl radical scavenging and βCBM. Extracts were also analyzed for chemical compositions and among the carotenoids, Lutein (**Figure 5D**) had highest concentration (in leaves).[173]

Aqueous extracts of collected leaves and 15 herbal medicines containing them, were prepared. These extracts were analyzed for TPC and tested with ABTS, FRAP and TEAC methods. They were chromatographed resulting eight known major phenolics.[174]

Three cell lines were cultured from juice in mainly light/dark different conditions. These were chromatographed resulting the identification of 17 active compounds, including Mulberroside F (**Figure 5D**). The juices decreased the H_2O_2-induced oxidative stress in LPS-stimulated Caco-2 cells. Anti-inflammatory activity is reported.[175,178]

Leaves 70% aqueous ethanolic extract was analyzed for GCC, TFC and TPC. It was tested using DPPH, FRAP superoxide anion scavenging, hydroxyl radical scavenging and Fe^{+2}

chelating methods. The extract had positive effect on human erythrocytes, measured with several parameters including MDA level and TBARS method.[176]

Leaves 95% aqueous ethanolic extract was analyzed for TPC and tested with ABTS and FRAP methods. It had protective effect against Paraquat-induced toxicity in RAW 264.7 cells, including amelioration of oxidative stress. Antiapoptotic effect is reported. [177]

Fruits 80% aqueous ethanolic extract was analyzed for GCC, TFC, TPC and total anthocyanin content. It was also analyzed for nutritional values and mineral and fatty acids compositions. It was tested using DPPH method.[179]

Phenolics-rich leaves ethanolic and aqueous extracts were prepared and analyzed for TFC and TPC and tested for superoxide anion radicals scavenging activity.[180]

Phenolics-rich fruits methanolic extract was prepared and analyzed for chemical composition resulting known compounds. It was tested using ABTS and DPPH methods. α-Glucosidase inhibition activity is reported.[181,182]

Leaves were separately extracted with methanol, 80% aqueous methanol, ethanol and 80% aqueous ethanol. Each extract was analyzed for TFC and TPC, and tested using DPPH, FRAP and Linoleic acid peroxidation methods. Antimicrobial activity is reported.[183]

Fruits and leaves were separately extracted with 80% aqueous methanol using three methods: ultrasonic assisted, stirring and homogenization. Each of the six resulting extracts was analyzed for TPC, total sugar content, and tested using DPPH method. The extracts were chromatographed for phenolic acids: Chlorogenic acid was major component in leaves while gallic acid was major component in fruits.[184]

Fruits were separately analyzed for nutritional values and extracted with methanol. The extract was tested with DPPH method.[185]

Fruits (white and purple) were separately analyzed for nutritional values and extracted with 80% aqueous methanol. The resulting extract was analyzed for TFC, TPC and tested with DPPH method.[186]

Fruits juice was analyzed for nutritional values, TFC, TPC and tested using CUPRAC, DPPH and FRAP methods.[187]

Leaves were successively extracted with PE, chloroform and methanol. The extracts were analyzed for TFC and TPC and tested with TAC, FRAP, DPPH, hydroxyl radical scavenging, Fe^{+2} chelating activity and nitric oxide radical scavenging methods. The methanolic extract was chromatographed affording known compounds including Cathafuran B (**Figure 5D**). Molecular docking for anticancer activity (the major topic of this publication) was performed for several active isolated compounds.[188]

Fruits syrup (from juice) was analyzed for TFC and TPC and tested with DPPH and FRAP methods. The juice was chromatographed affording known phenolics. Processing effect is presented.[189]

Stems that were collected in four different months were extracted with methanol, and the extracts were analyzed for TPC and total anthocyanin content. They were tested using DPPH method: the October extract was clearly most active.[190,191 correction]

Fresh juices from four genotypes were analyzed for partial nutritional value, TPC, total anthocyanin, and tested with DPPH and FRAP methods.[192]

Fruits, leaves and roots were separately extracted with 70% aqueous ethanol. The extracts were analyzed for TFC and TPC and tested using DPPH method. The extracts were chromatographed (HPLC) for six known phenolics.[193]

Fruits 75% aqueous acetone extract was analyzed for TFC and TPC and tested with TEAC method. The extract was analyzed (HPLC) resulting the identification of of ten known phenolics.[194]

Fruits were separately extracted with 80% aqueous acetone and 80% aqueous methanol. The extracts were analyzed for TPC and tested using ABTS and DPPH methods.[195]

Fruits methanolic extract was analyzed for TFC and TPC. It was supplemented to high fat-fed rats resulting ameliorating effect on oxidative stress. This effect was measured by several parameters including MDA, nitric oxide, LDL and TAC.[196]

Fruits of three genotypes were extracted with 20% aqueous ethanol, and the extract was analyzed for TPC and tested using CUPRAC method.[197]

Fruits methanolic extract was analyzed for TFC and TPC and tested using DPPH method. It

was administered separately or combined with *Morus nigra* extract, to Alloxan-induced diabetic rats and positive effects were detected (major topic of this publication).[198]

Fresh fruits were fed to rats with Carbon tetrachloride-induced toxicity resulting positive effect measured by several biomarkers, including alleviation of oxidative stress, measured mainly by MDA levels. Hepatoprotective activity is the major topic of this publication.[199]

Fruits juice (2 genotypes) was analyzed for nutritional values, aliphatic acids (5), phenolics (11) and tested using TEAC method.[200,204]

Fruits/leaves 80% aqueous methanolic extract was analyzed for nutritional values, TPC, and tested using ABTS and DPPH methods. It was chromatographed for phenolics resulting the identification of known compounds.[201,202]

The same findings published in reference 200 were published again a year later in a different journal.[203]

Leaves 80% aqueous ethanolic extract was analyzed for TFC and TPC and tested using TAC method.[205]

Fruits juice was analyzed for TPC, aliphatic acids (6), phenolics (14), monosaccharides and ascorbic acid. It was tested using TEAC method.[206,207]

Leaves 70% aqueous ethanolic extract was analyzed for known phenolics (14) and tested using hydroxyl radical scavenging and lipid peroxidation inhibition methods. It was also tested for AChE and BuChE inhibition and neuroprotection in zebrafish.[208]

Leaves phenolics-rich extract was analyzed for TFC, TPC, total anthocyanins and total carotenoids and was tested using DPPH method.[209]

Fruits juice was analyzed for aliphatic acids (7), monosaccharides (2), ascorbic acid, phenolics (13) and TPC. It was tested with TEAC method.[210]

Leaves 80% aqueous methanolic extract was analyzed for partial GCC, ascorbic acid content, TFC and TPC. It was tested using ABTS, DPPH and FRAP methods.[211]

Leaves and stem bark were separately extracted with 50% aqueous methanol. The extracts

were analyzed for TFC and TPC, and were tested with ABTS, DPPH and FRAP methods. Antibacterial activity of the extracts is reported.[212]

Fruits and leaves were separately extracted with 70% aqueous ethanol and the extracts were analyzed for TPC, total carbohydrate content and tested using DPPH and FRAP methods. The carbohydrate content was also analyzed for mono and polysaccharides.[213]

Fruits juice was analyzed TFC, TPC, partial nutritional value, total carotenoids content and total anthocyanin content. It was tested using DPPH and TEAC methods.[214]

Fruits juice was analyzed for TFC, TPC and tested using DPPH method. Analysis for single phenolics resulted the identification of sixteen known compounds.[215]

Fruits 70% aqueous ethanolic extract was partitioned with four solvents, and the crude extract and the fractions were tested using DPPH method. The *n*-hexane fraction was analyzed (GC-MS) affording 20 known non-polar compounds. Analysis for fatty acids yielded 17 compounds. One of the identified compounds was Cyclomulberrin (**Figure 5D**). Antiproliferative activity is reported.[216]

Fruits juice was analyzed for aliphatic acids (6), sugars (3), ascorbic acid content, phenolics (14), and it was tested with TEAC method.[217]

Fruits 70% aqueous ethanolic extract was analyzed for TPC. It was administered to rats brain with A*l*C*l*$_3$-induced damage, and the extract had neuroprotective activity, measured with several parameters, including NO production inhibition, CAT, SOD, protein carbonyl, and AChE inhibition.[218]

Fruits in three maturity stages, unripe, semi-ripe and fully ripe; were separately extracted with 80% aqueous methanol. The extract of ripe fruits had higher TFC, TPC and was obtained in higher yield. Analysis for (known) phenolics resulted the same pattern. Strawberry was also studied in this research.[253]

Morus atropurpurea

Fruits 80% aqueous ethanolic extract was analyzed for nutritional value, minerals, TFC, TPC, total anthocyanin content and fatty acids composition. It was tested using DPPH method. This is a comparative study of four species and eight cultivars.[81]

Fruits 80% aqueous ethanolic extract was analyzed for GCC, TFC, TPC and total anthocyanin content. It was also analyzed for nutritional values and mineral and fatty acids compositions. It was tested using DPPH method.[179]

Phenolics-rich leaves ethanolic and aqueous extracts were prepared and analyzed for TFC and TPC and tested for superoxide anion radicals scavenging activity.[180]

Phenolics-rich fruits methanolic extract was prepared and analyzed for chemical composition resulting known compounds. It was tested using ABTS and DPPH methods. α-Glucosidase inhibition activity is reported.[181,182]

Fruits 70% slightly acidic aqueous acetone extract was analyzed for TPC and total anthocyanin content and tested using ORAC method. Analysis for phenolics afforded eight known compounds and analysis for lipophilic antioxidants yielded eight known compounds as well, including Neoxanthin and Violaxanthin (**Figure 6**). Twenty-seven cultivars were used in this research.[219]

Fruits phenolics-rich methanolic extract was tested with ABTS and TEAC methods. It was supplemented to mice resulting clear positive effect of cognitive promotion and enhancement of antioxidant enzymes.[220]

Fruits 70% aqueous ethanolic extract was prepared with a new method, analyzed for sugar and anthocyanin contents. It was tested using ABTS and DPPH methods. Analysis for single phenolics afforded five known compounds including Peonodin-3-xylosylrhamnoside (the aglycon is shown in **Figure 6**).[221]

Follow up of the previous study with *in vitro* bioaccessibility of the anthocyanins in simulated gastro-intestinal digestion.[222]

Leaves 80% polysaccharide-rich, ultrasonic-assisted aqueous ethanolic extract was obtained under optimized conditions (temperature, time, pH and solvents ratio). It was tested using DPPH method.[223]

Fruits were harvested in four different ripening stages times (May) and were extracted with slightly acidic methanol. The extracts were analyzed for TFC, TPC and total anthocyanin content, and were tested with ABTS and DPPH methods. Analysis for single phenolics

afforded 19 known compounds. Neuroprotective activity is reported in detail.[224]

Leaves protein-rich, ultrasonic-assisted aqueous methanolic extract was analyzed for TPC, sugar content and amino acids. It was tested using DPPH, hydroxyl radical scavenging and reducing power (of albumin) methods.[225]

Fruits regular or ultrasonically-assisted extracts were prepared using eleven solvents/mixtures. The extracts were analyzed for TPC and tested using ABTS, DPPH and FRAP methods. Analysis for single phenolics afforded 22 known compounds.[226]

Leaves ultrasound-assisted 70% aqueous ethanolic extract was analyzed for TPC and tested using DPPH and ORAC methods. Analysis for single phenolics yielded fourteen known compounds. Antiobesity activity is reported in detail.[227]

Fruit juices of four cultivars were analyzed for TPC and tested using ABTS, DPPH and FRAP methods. Juices were extracted with 80% aqueous acetone, and the extracts were analyzed for single phenolics, yielding known compounds.[228]

Follow up of the research cited by reference 225: in this study, cellular antioxidant activity was tested (HepG2 cells). Hemolysis inhibition ability is reported.[229]

Morus australis

Leaves methanolic extract was administered to rats with acetaminophen-induced liver damage, and to Hep2G cancer cells. The result was alleviation of oxidative stress measured with CAT, GSH and SOD. Anti-inflammatory activity with proposed mechanism are presented.[230]

Roots microwave-assisted 95% aqueous ethanolic extract was analyzed for TFC, TPC and for single phenolics resulting the identification of Morusin as major component. The extract ameliorated oxidative stress in LPS-treated RAW 264.7 cells and in mice with CCl_4-induced liver damage. Anti-inflammatory activity is reported.[231]

Morus bombycis

Roots were separately extracted with chloroform, ethanol, 80% aqueous ethanol, methanol, 80% aqueous methanol and water. The extracts were tested with SOD-like and lipid peroxidation methods.[232]

Follow up of previous research: roots 80% aqueous methanolic extract was chromatographed affording 2,5-Dihydroxy-4,3'-di(1-β-D-glucopyranosyloxy)-*trans*-stilbene (**Figure 7**), which was tested in the same method.[233]

Follow up of previous two studies: effect of 2,5-Dihydroxy-4,3'-di(1-β-D-glucopyranosyloxy)-*trans*-stilbene in STZ-induced diabetic rats. Antidiabetic activity is the major topic of this publication.[234]

Branches 70% aqueous ethanolic extract and commercial Oxyresveratrol activated FOXO3a (Forkhead box O3, human gene) in HEF cells enabling decrease of ROS.[235]

Morus cathayana

Fruits 80% aqueous ethanolic extract was analyzed for nutritional value, minerals, TFC, TPC, total anthocyanin content and fatty acids composition. It was tested using DPPH method. This is a comparative study of four species and eight cultivars.[81]

Fruits 80% aqueous ethanolic extract was analyzed for GCC, TFC, TPC and total anthocyanin content. It was also analyzed for nutritional values and mineral and fatty acids compositions. It was tested using DPPH method.[179]

Phenolics-rich leaves ethanolic and aqueous extracts were prepared and analyzed for TFC and TPC and tested for superoxide anion radicals scavenging activity.[180]

Stem bark 95% aqueous ethanolic extract was chromatographed yielding three new compounds Cathayanons C, D and E, in addition to a known compound Sanggenon C (**Figure 8**), were isolated from the stem bark of Morus cathayana. Cathayanon D had significant MDA inhibition activity.[236]

Morus celtidifolia

Leaves were successively extracted with *n*-hexane and methanol, and the extracts were tested using DPPH method. Antibacterial and anticancer activities are reported.[237]

Morus indica

Leaves powder was fed to STZ-induced diabetic rats resulting decrease of oxidative stress. The effect was measured with several parameters especially GSH, MDA and SOD.[238]

Plant material (not indicated) was successively extracted with several solvents including

methanol, and this extract ameliorated 12-*O*-Tetradecanoyl-phorbol-13-acetate-induced oxidative stress in mice. Effect was measured mainly with GSH, MDA and SOD. Anticancer activity is extensively reported.[239]

Leaves were separately extracted with acetone, methanol and water and the extracts were analyzed for TPC. They were tested using DPPH, TBARS (oil) and lipid peroxidation inhibition methods.[240]

Leaves powder and methanolic extract were tested using DPPH, TBARS (edible oil in various temperatures) methods.[241]

Leaves were extracted with 70% aqueous ethanol, and the extract was supplemented to Alloxan-induced diabetic rats, separately or in combination with leaves 90% aqueous ethanolic extract of *Asystasia gangetica*. Results showed clear oxidative stress alleviation, expressed by CAT. GHS and SOD blood serum levels, and lipid peroxidation.[242]

For TPC determination, leaves were separately extracted with acidic 50% aqueous methanol and 70% aqueous acetone. For antioxidant activity (DPPH, FRAP, RPA and lipid peroxidation inhibition methods), leaves 80% aqueous methanolic extract was used.[243,244]

Leaves powder was fed to STZ-induced diabetic rats, resulting positive effect on several biomarkers including CAT, GSH, MDA.[245]

Leaves 70% aqueous ethanolic extract was supplemented to rats that had damage induced by consuming repeatedly used edible oil. Clear positive effect of oxidative stress amelioration was observed: CAT, SOD, TBRAS. GCC is published.[246]

Leaves powder was fed to rats with CCl_4-induced hepatotoxicity, resulting positive effect on several biomarkers including GSH and lipid peroxidation inhibition.[247]

DNJ was isolated from leaves and supplemented to patients with stable angina pectoris with coronary heart disease, resulting positive effects on several parameters including MDA and SOD. Anti-inflammatory activity is reported in detail.[248]

Leaves of six varieties were separately extracted with ethanol, methanol and water. The extracts were analyzed for GCC, TFC, alkaloids and terpenoids. The extracts were tested using DPPH method. Anticancer activity is the major topic of this publication.[249]

Roots 70% aqueous ethanolic extract was supplemented to rats with CCl_4-induced hepatotoxicity, resulting positive effect on several biomarkers including CAT, GSH, GPx and MDA. Hepatoprotective activity is the major topic of this publication.[250]

Leaves aqueous extract was tested with DPPH method. Antibacterial activity is reported.[251]

Morus laevigata

Leaves were separately extracted with methanol, 80% aqueous methanol, ethanol and 80% aqueous ethanol. Each extract was analyzed for TFC and TPC, and tested using DPPH, FRAP and Linoleic acid peroxidation methods. Antimicrobial activity is reported.[183]

Fruits and leaves were separately extracted with 80% aqueous methanol using three methods: ultrasonic assisted, stirring and homogenization. Each of the six resulting extracts was analyzed for TPC, total sugar content, and tested using DPPH method. The extracts were chromatographed for phenolic acids: Chlorogenic acid was major component in leaves while gallic acid was major component in fruits.[184]

Fruits (black and white) were separately analyzed for nutritional values and extracted with methanol. The extract was tested with DPPH method.[185]

Fruits were separately analyzed for nutritional values and extracted with 80% aqueous methanol. The extract was analyzed for TFC, TPC and tested with DPPH method.[186]

Fruits juice was analyzed for nutritional values, TFC, TPC and tested using CUPRAC, DPPH and FRAP methods.[187]

Leaves were successively extracted with PE, chloroform and methanol. Extracts were analyzed for TFC and TPC and tested with TAC, FRAP, DPPH, hydroxyl radical scavenging, Fe^{+2} chelating activity and nitric oxide radical scavenging methods. The methanolic extract was chromatographed affording known compounds. Molecular docking for anticancer activity (the major topic of this publication) was performed for several active isolated compounds.[188]

Leaves aqueous extract was tested with DPPH method. Antibacterial activity is reported.[251]

Fruits in three maturity stages, unripe, semi-ripe and fully ripe; were separately extracted with 80% aqueous methanol. The extract of ripe fruits had higher TFC, TPC and was

obtained in higher yield. Analysis for (known) phenolics resulted the same pattern.[253]

Morus latifolia

Leaves aqueous extract was tested with DPPH method. Antibacterial activity is reported.[251]

Bark and leaves were extracted with methanol with ultrasonication, and the extracts were tested using DPPH method. Antiproliferative activity is the major topic of this publication.[252]

Morus lhou

Fruits syrup (from juice) was analyzed for TFC and TPC and tested with DPPH and FRAP methods. The juice was chromatographed affording known phenolics. Processing effect is presented.[189]

Morus macroura

Leaves were separately extracted with methanol, 80% aqueous methanol, ethanol and 80% aqueous ethanol. Each extract was analyzed for TFC and TPC, and tested using DPPH, FRAP and Linoleic acid peroxidation methods. Antimicrobial activity is reported.[183]

Fruits in three maturity stages, unripe, semi-ripe and fully ripe; were separately extracted with 80% aqueous methanol. The extract of ripe fruits had higher TFC, TPC and was obtained in higher yield. Analysis for (known) phenolics resulted the same pattern.[253]

Stem bark ethanolic extract was partitioned with several solvents and chromatographed yielding five new compounds Guangsangons F-J, along with two known compounds, Mulberrofuran J and Kuwanon J (**Figure 9A**). Guangsangons H, I, and J inhibited MDA production in platelet activating factor-induced of rat polymorphonuclear leukocytes. Anti-inflammatory activity is reported.[254]

Follow up of the previous study, by the same group, using the same methods and tests: four new Guangsangons K, L, M, N, together with two known compounds, Mulberrofurans G and K (**Figure 9B**).[255]

Follow up of the previous two studies, by the same group, using the same methods and tests: Guangsangon O (**Figure 9B**).[256]

Fruits were mixed with yogurt to prepare a new drink that was analyzed for TPC ad was

tested using DPPH method.[257]

Fruits 80% aqueous methanolic extract was analyzed for TPC and was supplemented to rats with ethanol-induced gastric ulcer. Positive effects were measured including levels of GSH and MDA. HPLC analysis for single compounds afforded 20 phenolics, 4-Aminobenzene and Coumarin. GC-MS analysis (after silylation) yielded 18 compounds.[258]

Fruits, leaves and stems were separately extracted with 80% aqueous methanol. Extracts were supplemented to rats with Cisplatin-induced neurotoxicity, resulting clear alleviation of oxidative stress (GSH, MDA levels). HPLC analysis of the extracts afforded a total of 90 compounds. Anticancer and neuroprotective activities are the major topics of this article.[259]

Morus microphylla

Fruits syrup (from juice) was analyzed for TFC and TPC and tested with DPPH and FRAP methods. The juice was chromatographed affording known phenolics. Processing effect is presented.[189]

Morus multicaulis

Fruits 80% aqueous ethanolic extract was analyzed for nutritional value, minerals, TFC, TPC, total anthocyanin content and fatty acids composition. It was tested using DPPH method. This is a comparative study of four species and eight cultivars.[81]

Fruits 80% aqueous ethanolic extract was analyzed for GCC, TFC, TPC and total anthocyanin content. It was also analyzed for nutritional values and mineral and fatty acids compositions. It was tested using DPPH method.[179]

Phenolics-rich leaves ethanolic and aqueous extracts were prepared and analyzed for TFC and TPC and tested for superoxide anion radicals scavenging activity.[180]

Morus mesozygia

Methanolic trunk bark was chromatographed affording five new compounds, Moracins Q–U. In addition, eight known compounds were isolated: 3β-Acetoxyurs-12-en-11-one, Marsformoxide B, Moracin C, Moracin K, Artocarpesin, Cycloartocarpesin, Morachalcone A (**Figure 10**) and Moracin M. The new compounds were tested using DPPH method.[260]

Follow up of the previous study by the same group, using the same methods and tests, yielded

the isolation of three new compounds, Moracins KM, LM, and SC (**Figure 10**), along with nine other known compounds. Hepatoprotective activity is reported.[261]

Leaves acetone extract was analyzed for TFC and TPC and tested using DPPH and FRAP methods. Eight other plants were studied in this research. Anti-inflammatory activity is the major topic of this publication.[262]

Stem bark 80% aqueous methanolic extract was analyzed for TFC and TPC and tested using DPPH method. Anti-inflammatory activity is the main topic of this article.[263]

Morus mongolica

Research by the same group cited in references 236, 254, 255, 256, using the same methods and the same tests yielded two new compounds, Kuwanon L and Dimoracin (**Figure 11A**), along with four known compounds.[264]

Follow up of the previous study, by the same group afforded five new compounds, Mongolicin A, Mongolicin B, Mongolicin C, Mongolicin D, Mongolicin E, and nine known compounds including Mongolicin F (**Figure 11B**). Anti-inflammatory activity is reported.[265]

***Morus ssp.* (Unspecified)**

Cake that contained fruits was extracted with methanol and the extract was analyzed for TPC and tested using DPPH, superoxide anion and hydroxyl radicals scavenging method. It was analyzed for chemical composition yielding known compounds.[266]

Leaves were harvested in four different times and separately extracted with three different methods and eleven solvents (optimization). In addition, the chemical composition analysis was also optimized, resulting the identification of 74 known compounds. The extracts were tested using DPPH method showing clear dependence on harvest time, extraction method and extraction solvent.[267]

Morus multicaulis

Powdered branch bark was supplemented to STZ-induced diabetic mice resulting positive effect on several parameters, including GSH, MDA and SOD levels. Antidiabetic activity is the major topic of this publication.[268,270]

Fruits juice was prepared under various conditions of temperature and hydrostatic pressure

and analyzed for TFC, TPC and resveratrol content. It was tested using ORAC method. It was also analyzed for volatile components yielding 48 known compounds.[269]

Morus nigra

Phenolics-rich fruits methanolic extract was prepared and analyzed for chemical composition resulting known compounds. It was tested using ABTS and DPPH methods. α-Glucosidase inhibition activity is reported.[181,182]

Leaves were separately extracted with methanol, 80% aqueous methanol, ethanol and 80% aqueous ethanol. Each extract was analyzed for TFC and TPC, and tested using DPPH, FRAP and Linoleic acid peroxidation methods. Antimicrobial activity is reported.[183]

Fruits and leaves were separately extracted with 80% aqueous methanol using three methods: ultrasonic assisted, stirring and homogenization. Each of the six resulting extracts was analyzed for TPC, total sugar content, and tested using DPPH method. The extracts were chromatographed for phenolic acids: Chlorogenic acid was major component in leaves while gallic acid was major component in fruits.[184]

Fruits were separately analyzed for nutritional values and extracted with methanol. The extract was tested with DPPH method.[185]

Fruits were separately analyzed for nutritional values and extracted with 80% aqueous methanol. The extract was analyzed for TFC, TPC and tested with DPPH method.[186]

Stems that were collected in four different months were extracted with methanol, and the extracts were analyzed for TPC and total anthocyanin content. They were tested using DPPH method: the October extract was clearly most active.[190,191 correction]

Fruits, leaves and roots were separately extracted with 70% aqueous ethanol. The extracts were analyzed for TFC and TPC and tested using DPPH method. The extracts were chromatographed (HPLC) for six known phenolics.[193]

Fruits 75% aqueous acetone extract was analyzed for TFC and TPC and tested with TEAC method. The extract was analyzed (HPLC) resulting the identification of of ten known phenolics.[194]

Fruits were separately extracted with 80% aqueous acetone and 80% aqueous methanol. The

extracts were analyzed for TPC and tested using ABTS and DPPH methods.[195]

Fruits methanolic extract was analyzed for TFC and TPC. It was supplemented to high fat-fed rats resulting ameliorating effect on oxidative stress. This effect was measured by several parameters including MDA, nitric oxide, LDL and TAC.[196]

Fruits of four genotypes were extracted with 20% aqueous ethanol, and the extract was analyzed for TPC and tested using CUPRAC method.[197]

Fruits methanolic extract was analyzed for TFC and TPC and tested using DPPH method. It was administered separately or combined with *Morus alba* extract, to Alloxan-induced diabetic rats and positive effects were detected (major topic of this publication).[198]

Fresh fruits were fed to rats with Carbon tetrachloride-induced toxicity resulting positive effect measured by several biomarkers, including alleviation of oxidative stress, measured mainly by MDA levels. Hepatoprotective activity is the major topic of this publication.[199]

Fruits juice (3 genotypes) was analyzed for nutritional values, aliphatic acids (5), phenolics (11) and tested using TEAC method.[200,204]

Fruits 80% aqueous methanolic extract was analyzed for nutritional values, TPC, and tested using ABTS and DPPH methods. It was chromatographed for phenolics resulting the identification of known compounds.[201,202]

The same findings published in reference 200 were published again a year later in a different journal.[203]

Leaves 80% aqueous ethanolic extract was analyzed for TFC and TPC and tested using TAC method.[205]

Fruits juice was analyzed for TPC, aliphatic acids (6), phenolics (14), monosaccharides and ascorbic acid. It was tested using TEAC method.[206,207]

Leaves 70% aqueous ethanolic extract was analyzed for known phenolics (14) and tested using hydroxyl radical scavenging and lipid peroxidation inhibition methods. It was also tested for AChE and BuChE inhibition and neuroprotection in zebrafish.[208]

Leaves phenolics-rich extract was analyzed for TFC, TPC, total anthocyanins and total carotenoids and was tested using DPPH method.[209]

Fruits juice was analyzed for aliphatic acids (7), monosaccharides (2), ascorbic acid, phenolics (13) and TPC. It was tested with TEAC method.[210]

Leaves 80% aqueous methanolic extract was analyzed for partial GCC, ascorbic acid content, TFC and TPC. It was tested using ABTS, DPPH and FRAP methods.[211]

Leaves and stem bark were separately extracted with 50% aqueous methanol. The extracts were analyzed for TFC and TPC, and were tested with ABTS, DPPH and FRAP methods. Antibacterial activity of the extracts is reported.[212]

Fruits and leaves were separately extracted with 70% aqueous ethanol and the extracts were analyzed for TPC, total carbohydrate content and tested using DPPH and FRAP methods. The carbohydrate content was also analyzed for mono and polysaccharides.[213]

Fruits juice was analyzed TFC, TPC, partial nutritional value, total carotenoids content and total anthocyanin content. It was tested using DPPH and TEAC methods.[214]

Fruits juice was analyzed for TFC, TPC and tested using DPPH method. Analysis for single phenolics resulted the identification of sixteen known compounds.[215]

Fruits in three maturity stages, unripe, semi-ripe and fully ripe; were separately extracted with 80% aqueous methanol. The extract of ripe fruits had higher TFC, TPC and was obtained in higher yield. Analysis for (known) phenolics resulted the same pattern.[253]

Three temperatures were used to dry leaves, prepare tea from the dried material and test it with DPPH method: 40, 50, 60 °C. The best results were obtained using 40 °C.[271]

Fruits flavonoid-rich 70% aqueous ethanolic extract inhibited LDL and red blood cells oxidation, *in vitro*. Effect was measured as MDA production inhibition.[272,273]

Fruits flavonoid-rich 70% aqueous methanolic extract was analyzed for TPC and single phenolics composition, resulted the identification of known compounds. It was tested using βCBM method.[274]

Fruits and leaves were separately extracted with methanol and water and the extracts were analyzed for TPC and tested using DPPH and lipid peroxidation inhibition methods.[275]

Fruits flavonoid-rich 70% aqueous methanolic extract was supplemented to rats resulting improvement of antioxidant-oxidant balance of blood plasma. Effect was measured with βCBM method. The absorption and metabolism of two cyanidin glycosides is extensively reported: pharmacokinetics and mechanism of action.[276]

Leaves aqueous extract was tested using DPPH and SOD-like methods. Four other plant species were included in this research.[277]

Bark 95% aqueous ethanolic extract was partitioned and chromatographed affording three new compounds, Mornigrol D, Mornigrol G and Mornigrol H; along with six known compounds, Norartocarpetin, Dihydrokaempferol, Albanin A, Albanin E, Albafuran C (**Figure 12A**) and Moracin M. Compounds Mornigrol D and Albafuran C inhibited MDA production in rat polymorphonuclear leucocytes induced by platelet activating-factor. Anti-inflammatory activity is also reported.[278]

Fruits phenolics-rich methanolic extract was analyzed for TPC and tested with βCBM, DPPH, FRAP and Fe^{+2} chelating methods.[279]

Leaves 70% aqueous ethanolic extract was analyzed for TPC and was tested using DPPH method. It was supplemented to Alloxan-induced diabetic rats resulting positive effects on several parameters including CAT, GSH and SOD levels.[280]

Leaves ethanolic extract was analyzed for GCC and ascorbic acid content. It was tested for effect on CAT, peroxidase and ascorbate oxidase activities. *Viola serpens* was also studied in this research.[281]

Ripe and unripe fruits were extracted with 80% aqueous methanol. The extracts were tested using DPPH, hydroxide radical scavenging and lipid peroxidation methods. They were analyzed for five known phenolics. In all tests mature fruits extract was more potent.[282]

Leaves aqueous extract was supplemented to pregnant STZ-induced female diabetic rats, resulting positive effects on several parameters including MDA and SOD levels.[283]

Fresh and fermented juices were analyzed for GCC and TPC and were tested with DPPH

method. Analysis for single phenolics revealed small differences.[284]

Fruits fresh juice was analyzed for TPC, ascorbic acid, total anthocyanins and trace elements contents. It was tested using DPPH, FRAP and TAC methods. Antimicrobial activity is the major topic of this publication.[285]

Stem bark acetone extract was fractionized with several solvents including EtOAc, and this fraction was used for further tests and chromatographed. Stem wood methanolic extract was chromatographed. Both materials were tested with DPPH method. Analysis of the EtOAc fraction afforded nine known compounds, including Kuwanon C (**Figure 12A**). Antibacterial activity is reported.[286]

Fruits phenolics-rich ethanolic extract was analyzed for TFC, TPC and tested using hydrogen peroxide scavenging, TAC, βCBM and FRAP methods. Effects of temperature and pH on antioxidant capacity are reported.[287]

Fresh fruits, dried fruits, fruits wine, fruits molasses, fruits ice cream, fruits juice, fruits jam and fruits syrup, were extracted with slightly acidic 75% aqueous methanol. The extracts were analyzed for TFC, TPC and total anthocyanin content. They were tested using ABTS, CUPRAC, DPPH and FRAP methods. They were also analyzed for four known anthocyanins: glucosides and rutinosides (3*O*) of Cyanidin and Pelargonidin.[288]

Frozen fruits were extracted with water, ethanol and slightly acidic 50% aqueous ethanol and the extracts were analyzed for TFC, TPC and total anthocyanin content. They were tested with ABTS and DPPH methods.[289]

Seeds were successively extracted with PE, EtOAc, ethanol and water. The extracts were analyzed for extended GCC, TPC and tested with DPPH and FRAP methods. Antidiabetic activity is reported.[290]

Fruits were analyzed for total acidity and were used to prepare wine. This was analyzed for TPC and tested using ABTS method. Partial chemical composition (GC-MS) is reported. *Chaenomeles japonica* and Cornus mas were also investigated in this research.[291]

Stem bark methanolic extract was partitioned with different solvents and chromatographed yielding a new compound, 2',3,4',5,5'-Pentahydroxy-*cis*-stilbene (1), along with 13 known

compounds, Cudraflavone A, Mulberrofuran G, Uvaol (**Figure 12A**), Resveratrol, Oxyresveratrol, Albafurane C, Norartocarpetin, Kuwanon C, Morusin, Kuwanon G, 3-*O*-Acetyl-α-amyrin, 3-*O*-Acetyl-β-amyrin and Ursolic acid-3-*O*-acetate. Compound 1 was active in ABTS test.[292]

Juices were prepared using several methods and stored in three temperatures. They were analyzed for TPC and anthocyanin content and tested using DPPH method. Kinetic study is presented.[293]

Fruits phenolics-rich 95% aqueous ethanolic extract was analyzed for TFC and tested for hydroxyl radical and superoxide anion scavenging. It was supplemented to mice resulting positive effect on several parameters including CAT, GHS, MDA, SOD levels.[294]

Fruits were harvested from several locations and were analyzed for total acidity. Methanolic extracts were prepared and were analyzed for GCC, mineral content, anthocyanin content and TFC. The extracts were tested using DPPH method.[295]

Fruits polysaccharides-rich 80% aqueous ethanolic extract was supplemented to rats with CCl_4-induced liver damage. It had positive effect on several parameters including CAT, GSH and SOD levels.[296]

Fresh and dried (two methods) fruits were separately extracted with 80% aqueous methanol, and the extracts were analyzed for five major phenolics and eight lipophilic compounds. They were supplemented to rats with Fenton-induced toxicity, resulting positive effect on several parameters including lipid peroxidation.[297]

Leaves methanolic extract was analyzed for phenolic acids (Vanillic and Chlorogenic acids were majors). It protected pBR322 plasmid DNA against H_2O_2 and UV damages. Effect against oxidative stress was measured with CAT, GPx, MDA and SOD levels. The protective effect in D-Galactose-induced aging mice is the main topic of this publication.[298]

Leaves 70% aqueous ethanolic extract was analyzed TFC and terpenes content and tested using DPPH method. It ameliorated Phorbol 12-myristate 13-acetate-induced oxidative stress in mice.[299]

Fruits DMSO extract was analyzed for TPC, phenolic acids (9) and tested using FRAP

method. The extract activity against human prostate cancer cells (PC-3) is the major topic of this publication.[300]

Fruits and some of their food products (juice, jam, jelly, syrup, liqueur, compote, wine and cake) were analyzed for total anthocyanin content, total sugar content, ascorbic acid content and pH. They were tested using DPPH method.[301]

Leaves teas were prepared in 70, 80, 90 and 100 °C. These were analyzed for TFC and TPC and tested with DPPH method. Antimicrobial activity of these teas is also reported.[302]

Fruits of eight cultivars were extracted with ethanol, and extracts were analyzed for TPC, total anthocyanin content, ascorbic acid content and tested using DPPH method.[303]

Fruits were defatted with PE and extracted with 38% aqueous ethanol. The extract was analyzed for TFC and major phenolics. It was tested using ABTS, DPPH, reducing power, hydroxyl radical and superoxide anion radical scavenging methods. It had anti-inflammatory and antinociceptive effects in mice, which are the major topics of this publication.[304]

Fruits were separately extracted with 50, 80 and 100% of acetone, ethanol and methanol. The resulting nine extracts were analyzed for TFC, TPC and tested using DPPH and reducing power methods. Analysis for phenolic acids indicated that Gallic acid was major. Antibacterial activity is reported.[305]

Fruits were separately extracted with chloroform, DEE, acetone, ethanol and methanol. The resulting extracts were analyzed for GCC and trace elements and tested using DPPH method. Antimicrobial activity is reported.[306]

Leaves were separately extracted with 70% aqueous methanol and water, and the extracts were analyzed for TPC, ascorbic acid content, and tested using DPPH method. They were supplemented to hyperlipidemic rats resulting positive effect on several parameters, including lipid peroxidation (TBARS) and MDA level.[307]

Leaves 90% aqueous ethanolic extract was analyzed for three major phenolics. It was administered to Alloxan-induced diabetic rats resulting positive effect on several parameters, including lipid peroxidation (TBARS) and MDA level.[308]

Leaves were separately extracted with ethanol and water and the extracts were supplemented to rats with CCl_4-induced brain damage. Results showed positive effect on several parameters including CAT and SOD levels.[309]

Commercial leaves extract was analyzed for TFC and TPC and tested using DPPH, FRAP and NO scavenging methods. It was supplemented to mice with Chagas disease Resulting positive effect on several parameters including MDA and SOD levels.[310]

Fruits commercial jams (produced with different methods) were extracted with 75% aqueous methanol, and the extracts were analyzed for TFC, TPC and total anthocyanin content. The extracts were tested using ABTS, CUPRAC, DPPH and FRAP methods.[311]

Fruit juice reduced oxidative stress (MDA levels) in ducks with high temperature-induced stress.[312]

Flowers of *Cynara cardunculus*, fruits of *Ficus carica* L. and *M. nigra* aqueous extracts had synergistic effect in treating CCl_4-treated HepG2 cells. Effect was measured with SOD levels. The extracts were analyzed for major phenolics.[313]

Fruits of *Rubus niveus* and *M. nigra* methanolic extracts were analyzed for TFC, TPC and total anthocyanin content and tested using DPPH method. The extracts were supplemented to mice with gastric damage (ethanol/HC*l*) resulting positive effect on several parameters including GSH levels.[314]

Leaves aqueous extract was analyzed (HPLC) yielding Syringic acid (**Figure 12B**) as major phenolic acid. The extract and this compound were supplemented to mice with stress resulting amelioration of oxidative stress. Anti-depression is the major topic of this publication.[315]

Leaves 95% aqueous ethanolic extract was fractionized with *n*-hexane, chloroform and EtOAc. The extract and fractions were analyzed for TFC, TPC and anthocyanin content. They were tested using βCBM, and DPPH methods, and for antibacterial and cytotoxic activities.[316]

Fruits phenolics-rich ethanolic extract was analyzed for GCC and tested using DNA nicking assay. Antibacterial activity is reported.[317]

Fruits 96% aqueous ethanolic extract was analyzed for GCC and tested using DPPH method. Antibacterial activity is reported.[318]

Fruits juice of 13 genotypes were analyzed for GCC, TPC, ascorbic acid content, and were tested using DPPH method. They were also analyzed for six major phenolics and four aliphatic acids and three soluble saccharides.[319]

Leaves and pulps were separately extracted with 50% aqueous ethanol, and the extracts were analyzed for twelve or seven major phenolics, respectively. The extracts were supplemented to mice with LPS-induced inflammation resulting positive effect on several parameters including GSH and SOD levels.[321]

Fruits were separately extracted with ethanol and water, and the extracts were supplemented to rats with CCl_4-induced liver damage, resulting positive effect on several parameters including GPx and SOD levels.[322]

Leaves were separately extracted with PE, chloroform, ethanol and water and the extracts were analyzed for GCC and were tested using DPPH method.[323]

Fruits were used to prepare phenolics-rich acetone and 96% aqueous ethanolic extracts. These extracts were supplemented to rats with 5-Fluorouracil-induced gastrointestinal mucositis. Tests showed positive effect on several parameters including CAT, GPx and SOD levels. Anti-inflammatory activity is also published.[324]

Fruits aqueous extract was analyzed for TPC and tested using DPPH and FRAP methods. It was used to prepare pasta meals for patients with type II diabetes, resulting positive effect on several parameters of antidiabetic activity, which is the major topic of this publication.[325]

Leaves ethanolic extract was analyzed for DNJ content, TFC and TPC and tested using DPPH method. It was also tested for α-glucosidase inhibition and supplemented to STZ-induced diabetic rats. Tests indicated positive effect on several parameters. *Bauhinia variegata* was also studied in this research.[326]

Fruits 96% aqueous ethanolic extract was analyzed for GCC and tested with DPPH method. The extract was used to prepare sunscreen gel.[327]

Fruits aqueous extract was analyzed for TPC and anthocyanin content, and tested using

DPPH, FRAP and ORAC methods. It was tested for AChE and BuChE inhibition and against β-Amyloid toxicity in PC12 neuronal cells and in *Drosophila*.[328]

Fruits were separately extracted with 75% aqueous ethanol and water, and both extracts were tested with DPPH method. They had anticancer activity against human colon cancer HCT-116 cells. Tests showed inhibition of ROS production.[329]

Fruits of eleven cultivars were extracted with 75% aqueous ethanol. The extracts were analyzed for organic acids (4), soluble saccharides (3), TPC and anthocyanin content and tested using DPPH and FRAP methods. Anticancer activity is published.[330]

Sour fruits 80% aqueous ethanolic extract was analyzed for TFC and TPC and tested using DPPH method. It had activity against HT-29 human colon cancer cells. A mechanism of action is presented.[331]

Fruits juice was analyzed for free sugars, aliphatic acids, tocopherols and anthocyanins. It was tested using TBARS and oxidative haemolysis inhibition assay methods. *Rubus fruticosus* is also studied in this research. Antimicrobial activity is published.[332]

Juices of 20 genotypes were analyzed for soluble saccharides (3), aliphatic acids (4), ascorbic acid content, TFC, TPC, anthocyanin content and phenolic acids (5). They were tested using DPPH and FRAP methods.[333]

Stems 70% aqueous ethanolic extract was partitioned with several solvents yielding a total of four extracts. They were analyzed for GCC, TFC and TPC. They were tested using DPPH, hydroxyl radical scavenging, βCBM and TAC methods. Cytotoxic activity is reported.[334]

Leaves 70% aqueous ethanolic extract was tested using DPPH method. It was chromatographed resulting Rutin and Isoquercetin as major phenolics. It was tested for antibacterial activity and used for preparing cosmetic emulsion.[335]

Leaves, bark and fruits were extracted with 70% aqueous ethanol, juice and seeds oil (super critical CO_2) were also prepared, and these materials were tested using DPPH and FRAP methods. They were analyzed for TPC and chemical compositions where Isoquercetin (**Figure 12B**) was the only detected phenolic that was present in the three extracts and juice. The oil was analyzed resulting major five known esters. All materials were supplemented to

mice with STZ-induced hepatotoxicity resulting positive effect on several parameters including CAT and SOD levels.[336]

A polyherbal mixture containing equal amount of *Ocimum basilicum* and *Morus nigra* (leaves, both) was separately extracted with *n*-hexane, chloroform, EtOAc and methanol. The extracts were analyzed for TFC and TPC and tested using DPPH method. The chloroform extract was analyzed with GC-MS where five major compounds were identified, including Selin-4,7(11)-diene (**Figure 12B**). Anticancer activity is the major topic of this publication.[337]

Fruits powder was analyzed for GCC and used for the production of flour confectionery products: butter with sesame oil. This lowered the peroxide numbers of the fats 1.7 times in average, compared with fats without fruits powder.[338]

Fruits concentrate was tested using ABTS method and was supplied to patients with mild to moderate Alzheimer's dementia. This resulted in positive effect on various parameters including SOD levels. Anti-inflammatory activity is published.[339]

Fruit juice (or phenolics-rich acetone extract) was analyzed for TPC, total anthocyanin content, total acidity and tested using TEAC and FRAP methods. It was analyzed for saccharides (3) and aliphatic acids (3).[340]

Fruits juice was analyzed for minerals, ascorbic acid content, total acidity, total anthocyanin content, TPC; and tested using DPPH and FRAP methods.[341]

Morus rubra

Fruits juice was analyzed for nutritional values, TFC, TPC and tested using CUPRAC, DPPH and FRAP methods.[187]

Fresh juices from four genotypes were analyzed for partial nutritional value, TPC, total anthocyanin, and tested with DPPH and FRAP methods.[192]

Leaves phenolics-rich extract was analyzed for TFC, TPC, total anthocyanins and total carotenoids and was tested using DPPH method.[209]

Fruits juice was analyzed for aliphatic acids (7), monosaccharides (2), ascorbic acid, phenolics (13) and TPC. It was tested with TEAC method.[210]

Leaves 80% aqueous methanolic extract was analyzed for partial GCC, ascorbic acid content, TFC and TPC. It was tested using ABTS, DPPH and FRAP methods.[211]

Leaves and stem bark were separately extracted with 50% aqueous methanol. The extracts were analyzed for TFC and TPC, and were tested with ABTS, DPPH and FRAP methods. Antibacterial activity of the extracts is reported.[212]

Fruits and leaves were separately extracted with 70% aqueous ethanol and the extracts were analyzed for TPC, total carbohydrate content and tested using DPPH and FRAP methods. The carbohydrate content was also analyzed for mono and polysaccharides.[213]

Fruits juice was analyzed TFC, TPC, partial nutritional value, total carotenoids content and total anthocyanin content. It was tested using DPPH and TEAC methods.[214]

Fruits juice was analyzed for TFC, TPC and tested using DPPH method. Analysis for single phenolics resulted the identification of sixteen known compounds.[215]

Fruits 70% aqueous ethanolic extract was partitioned with four solvents, and the crude extract and the fractions were tested using DPPH method. The *n*-hexane fraction was analyzed (GC-MS) affording 19 known non-polar compounds. Analysis for fatty acids yielded 17 compounds. Antiproliferative activity is reported.[216]

Fruits juice was analyzed for aliphatic acids (6), sugars (3), ascorbic acid content, phenolics (14), and it was tested with TEAC method.[217]

Fruits 70% aqueous ethanolic extract was analyzed for TPC. It was administered to rats brain with AlCl_3-induced damage, and the extract had neuroprotective activity, measured with several parameters, including NO production inhibition, CAT, SOD, protein carbonyl, and AChE inhibition.[218]

Fruit juice (or phenolics-rich acetone extract) was analyzed for TPC, total anthocyanin content, total acidity and tested using TEAC and FRAP methods. It was analyzed for saccharides (3) and aliphatic acids (3).[340]

Fruits juice was analyzed for minerals, ascorbic acid content, total acidity, total anthocyanin content, TPC; and tested using DPPH and FRAP methods.[341]

Fruits juice was analyzed for GCC, minerals, TPC, total anthocyanin content, ascorbic acid content, major phenolics (5); and it was tested using FRAP method.[342]

Fruits phenolics-rich DMSO extract was analyzed for TPC, major phenolics (8 and ascorbic acid), and tested using TEAC method. The extract was applied against human lung and prostate cancer cell, in comparison with Cisplatin.[343]

Phenolics-rich 70% aqueous methanolic extracts were separately prepared from unripe fruits, ripe fruits, leaves, petiole and stems. The extracts were tested using H_2O_2 scavenging and DPPH methods. Leaves extract was most active.[344]

Morus serrata

Leaves were successively extracted with PE, chloroform and methanol. Extracts were analyzed for TFC and TPC and tested with TAC, FRAP, DPPH, hydroxyl radical scavenging, Fe^{+2} chelating activity and nitric oxide radical scavenging methods. The methanolic extract was chromatographed affording known compounds. Molecular docking for anticancer activity (the major topic of this publication) was performed for several active isolated compounds.[188]

Morus wittiorum

Stem bark 95% aqueous ethanolic extract was fractionized with several solvents and chromatographed affording two new compounds Wittifuran D, Wittifuran E, along with Moracin P, Mulberroside C, 2-(3,5-Dihydroxyphenyl)-5,6-dihydroxybenzofuran (**Figure 13A**), Moracin C and Moracin M. Some of these compounds inhibited MDA production during microsomal lipid peroxidation induced by ferrous-cysteine.[345]

Follow up of the previous research by the same group, using the same methods and tests, afforded six new compounds, Wittiorumins A-F along with the three known compounds Chalcomoracin (**Figure 13A**), Mulberrofuran J and Mongolicin F.[346]

A second follow-up of previous two studies yielded four new compounds, Wittiorumin G, Wittifurans P-R, along with five known compounds, Sorocein A, Mulberrofuran E, Mulberrofuran F, Mulberrofuran O (**Figure 13B**) and Albafuran C.[347]

A third follow-up afforded five new compounds, Wittifuran S, Wittifuran T, Wittifuran V, Wittifuran W and Wittifuran X (**Figure 13C**). In addition to antioxidant activity, anti-

inflammatory activity was tested in this research.[348]

A fourth follow-up afforded five new compounds, Wittifuran A, Wittifuran B, Wittifuran C, Wittifuran F and Wittifuran G (**Figure 13C**). In addition to antioxidant activity, anti-inflammatory activity was tested in this research.[349]

Morus yunnanensis

The same research group of studies cited as[345-349], same tests and methods yielded Yunanensin A (new, two possible structures), Yunanensol A, Yunanensol B, together with a known flavone (no name provided) (**Figure 14**).[350]

Follow up of previous study afforded Mulberrofuran K, 3',5',2,4-Tetrahydroxy-4-(3-methyl-1-butenyl) stilbene (**Figure 14**), Mulberrofuran E, Albanol B, Kuwanon H, Resveratrol, Moracin M and Morachalcone A.[351]

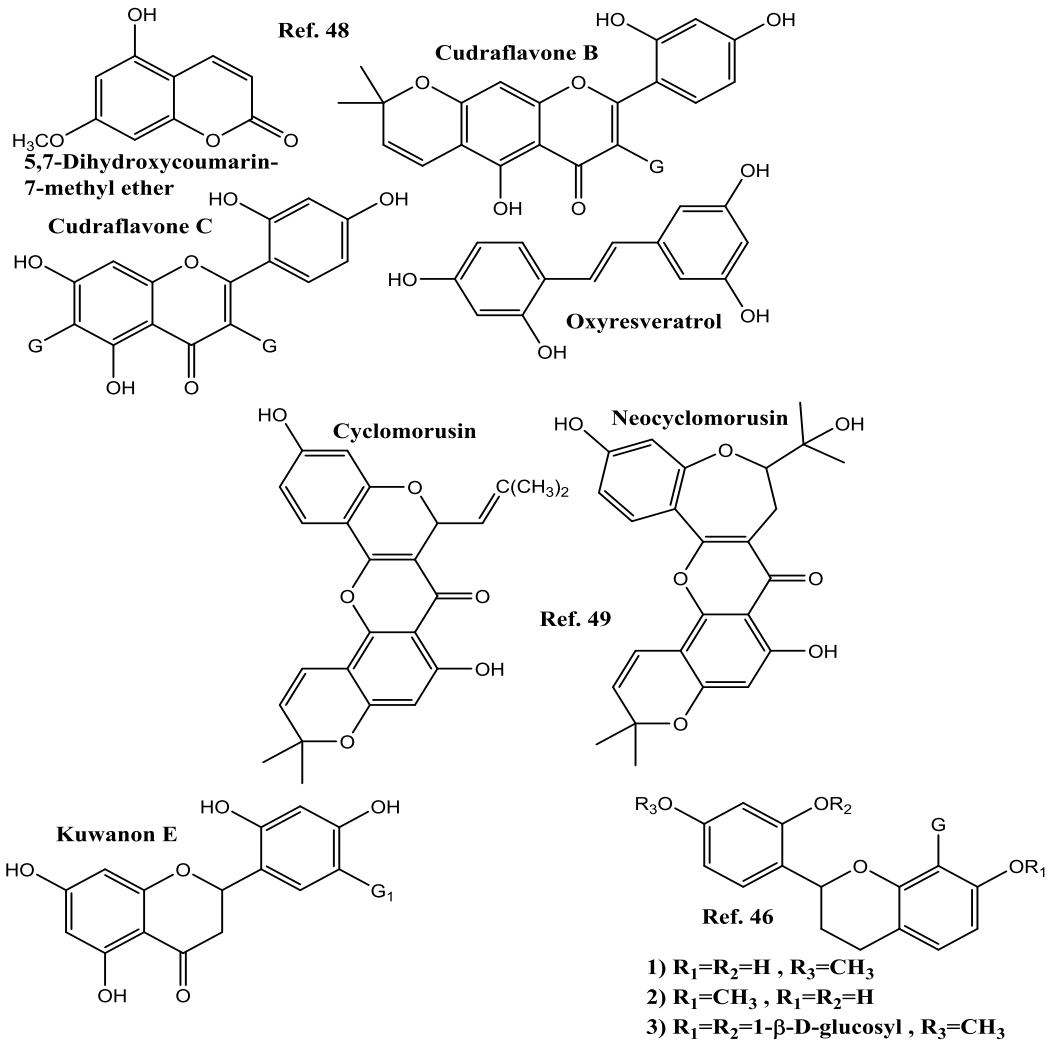


Figure 5A: Natural products isolated from *Morus alba.*

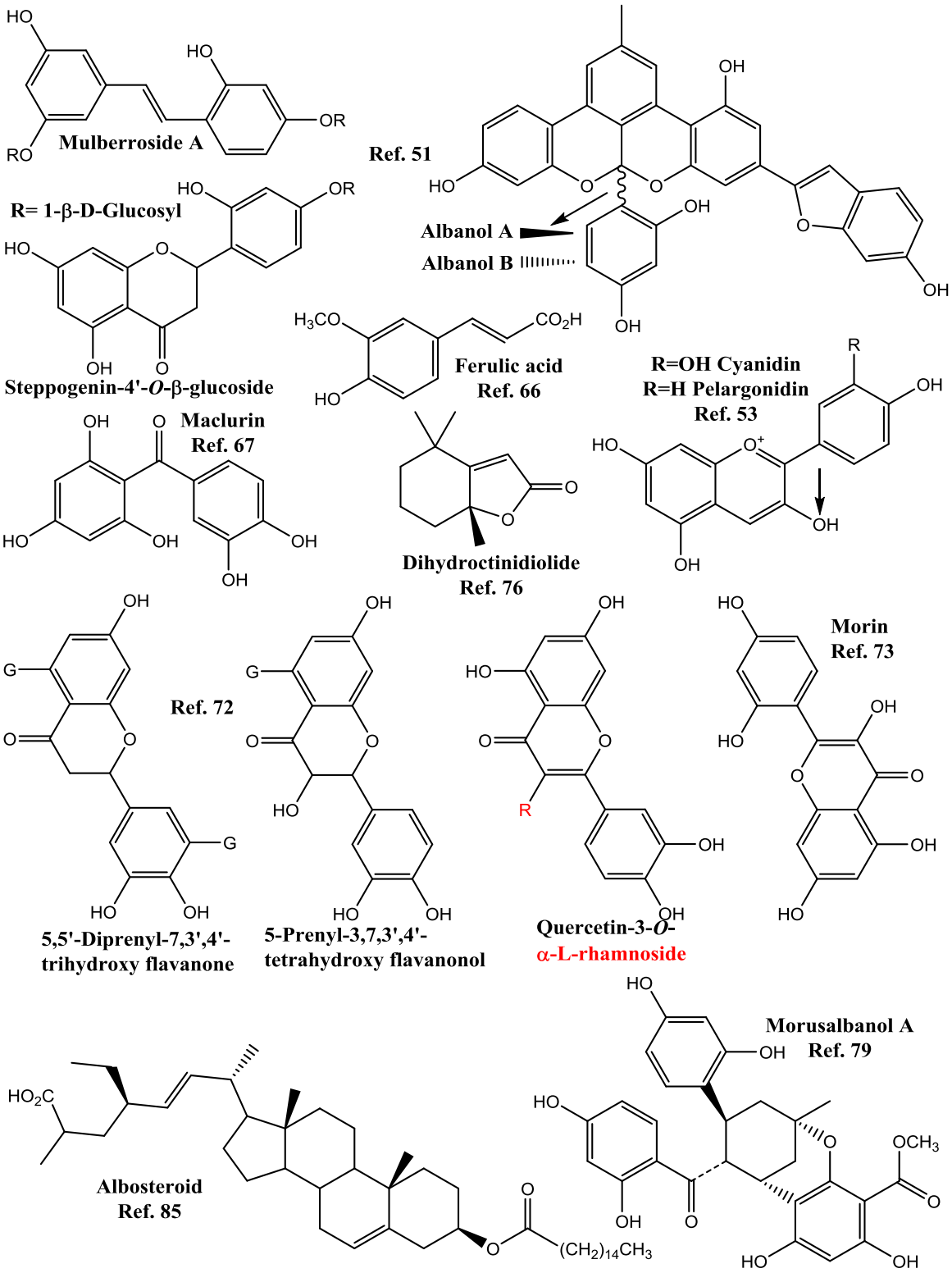


Figure 5B: Natural products isolated from *Morus alba.*

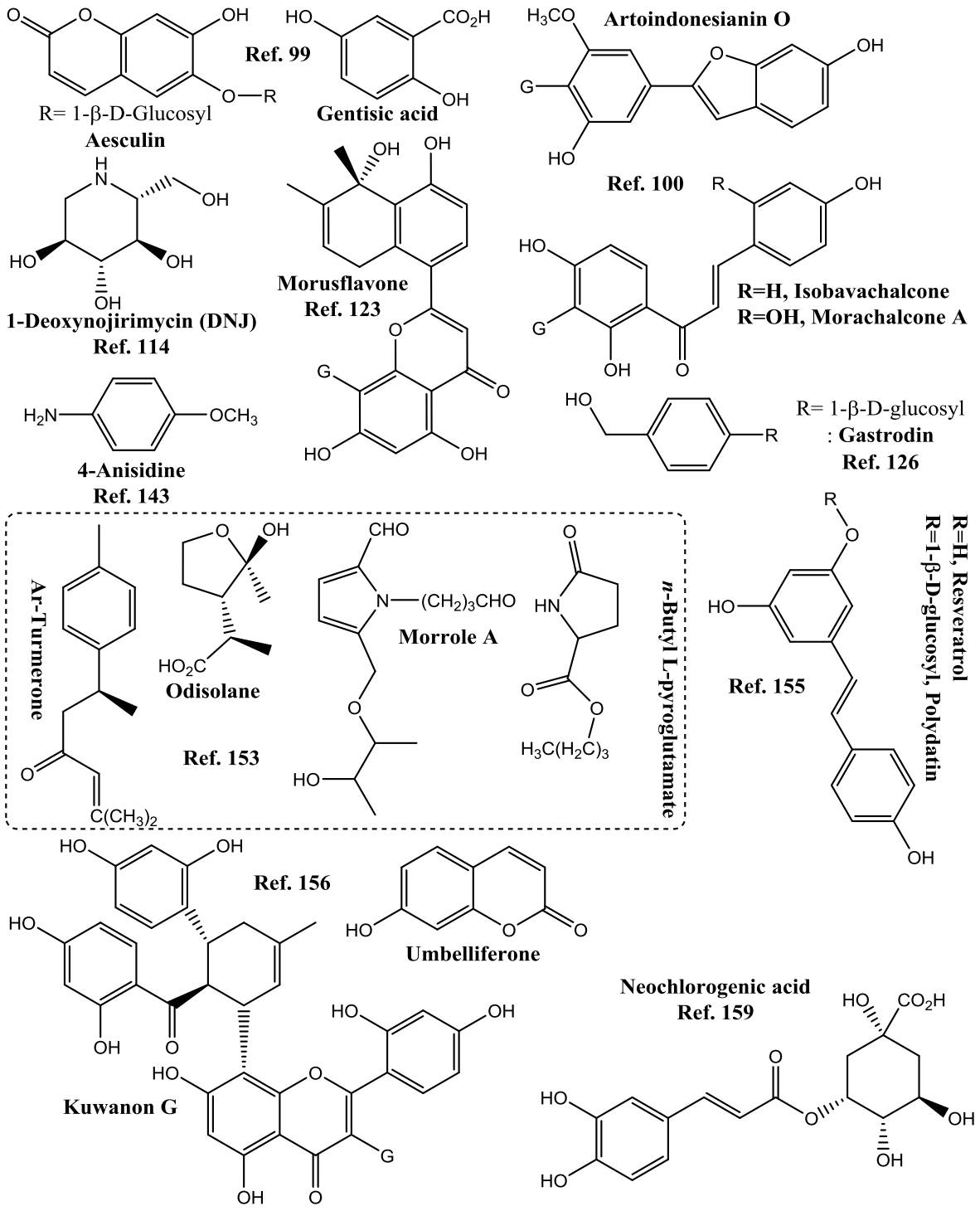


Figure 5C: Natural products isolated from *Morus alba*.

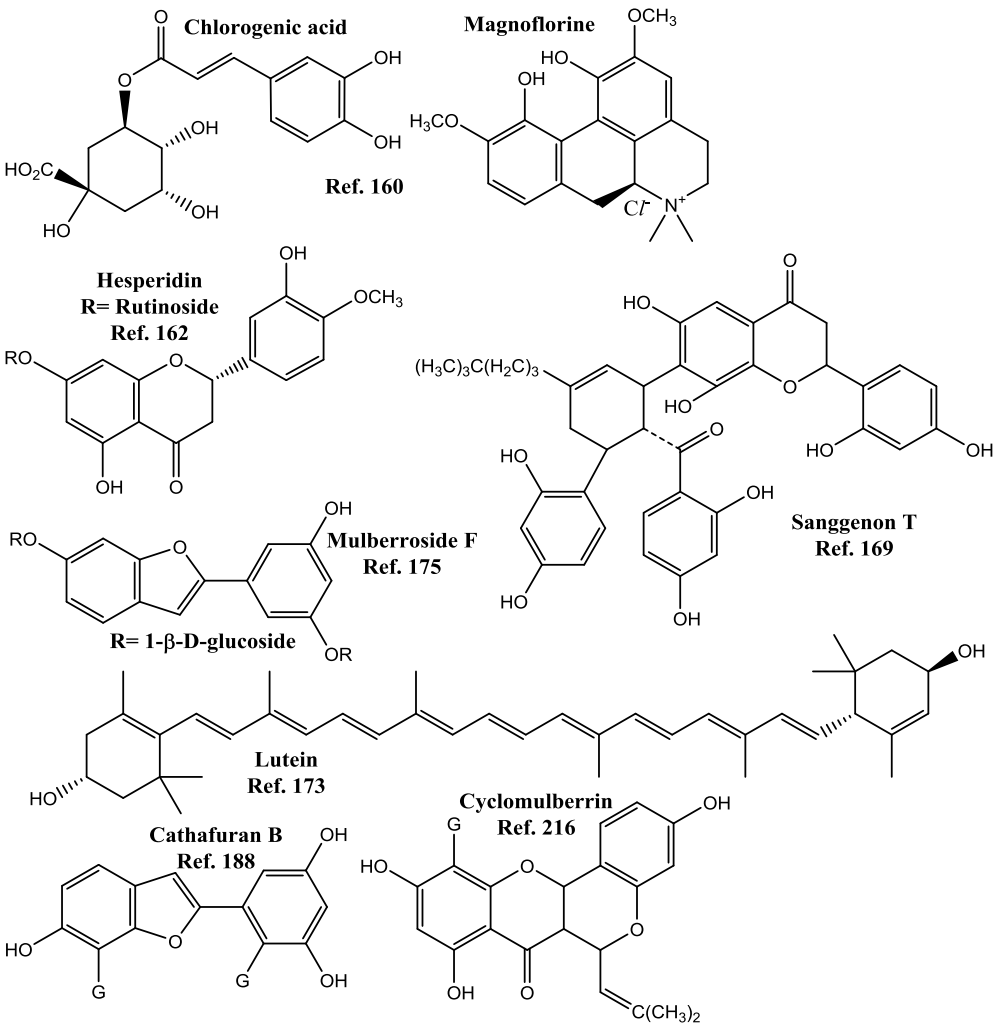


Figure 5D: Natural products isolated from *Morus alba.*

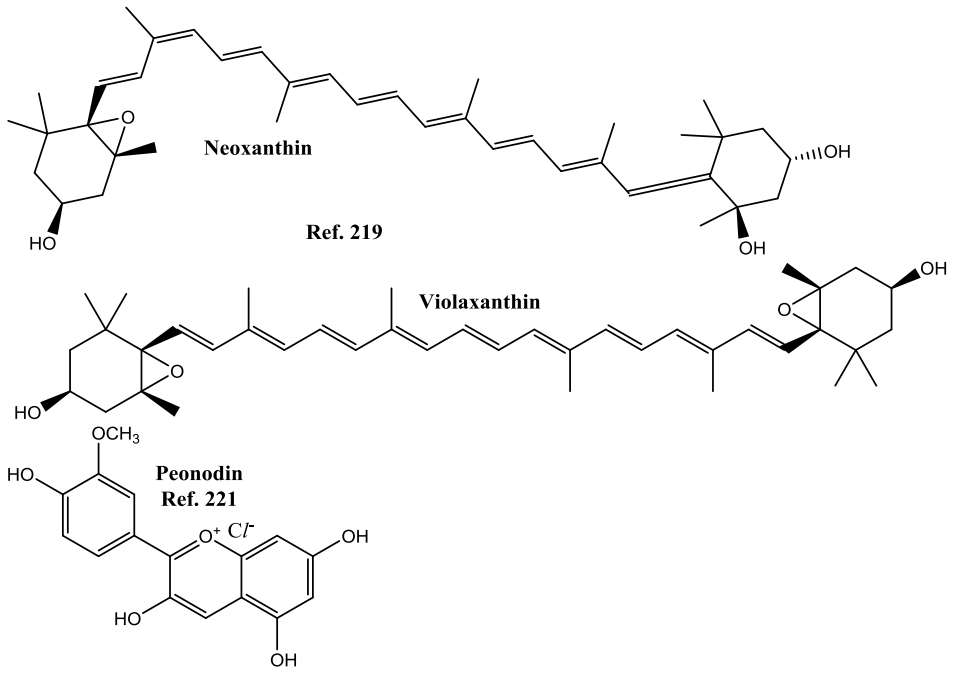
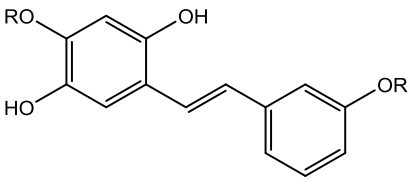


Figure 6: Natural products isolated from *Morus atropurpurea.*



2,5-Dihydroxy-4,3'-di(1-β-D-glucopyranosyloxy) -trans-stilbene
Ref. 233

Figure 7: Natural products isolated from *Morus bombycis.*

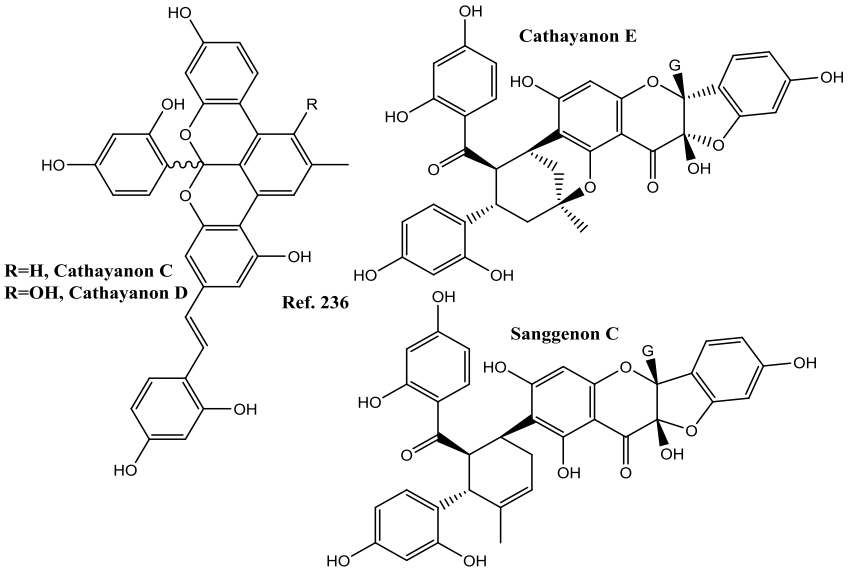


Figure 8: Natural products isolated from *Morus cathayana.*

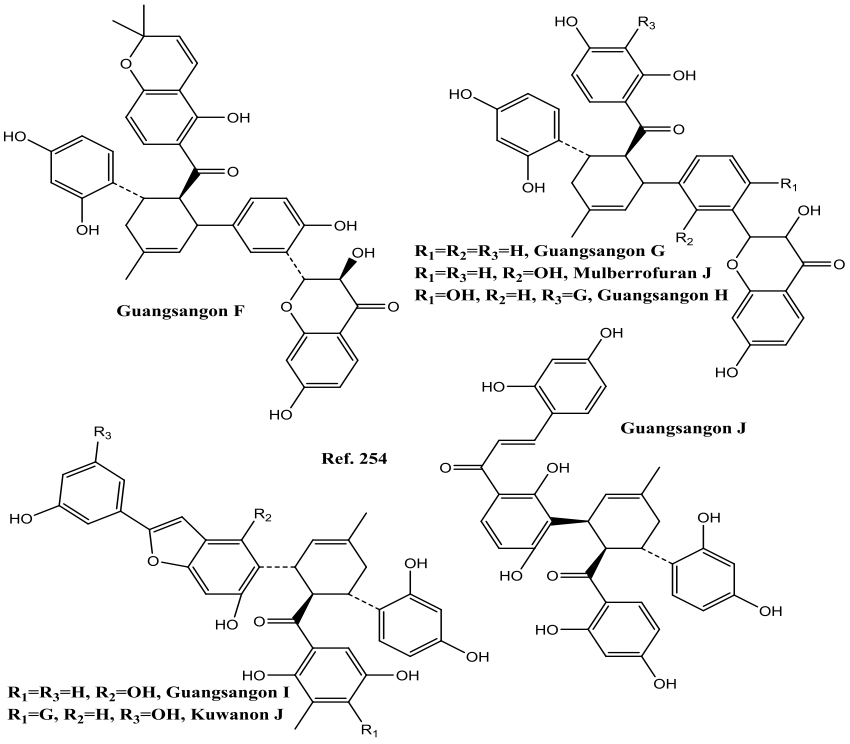


Figure 9A: Natural products isolated from *Morus macroura.*

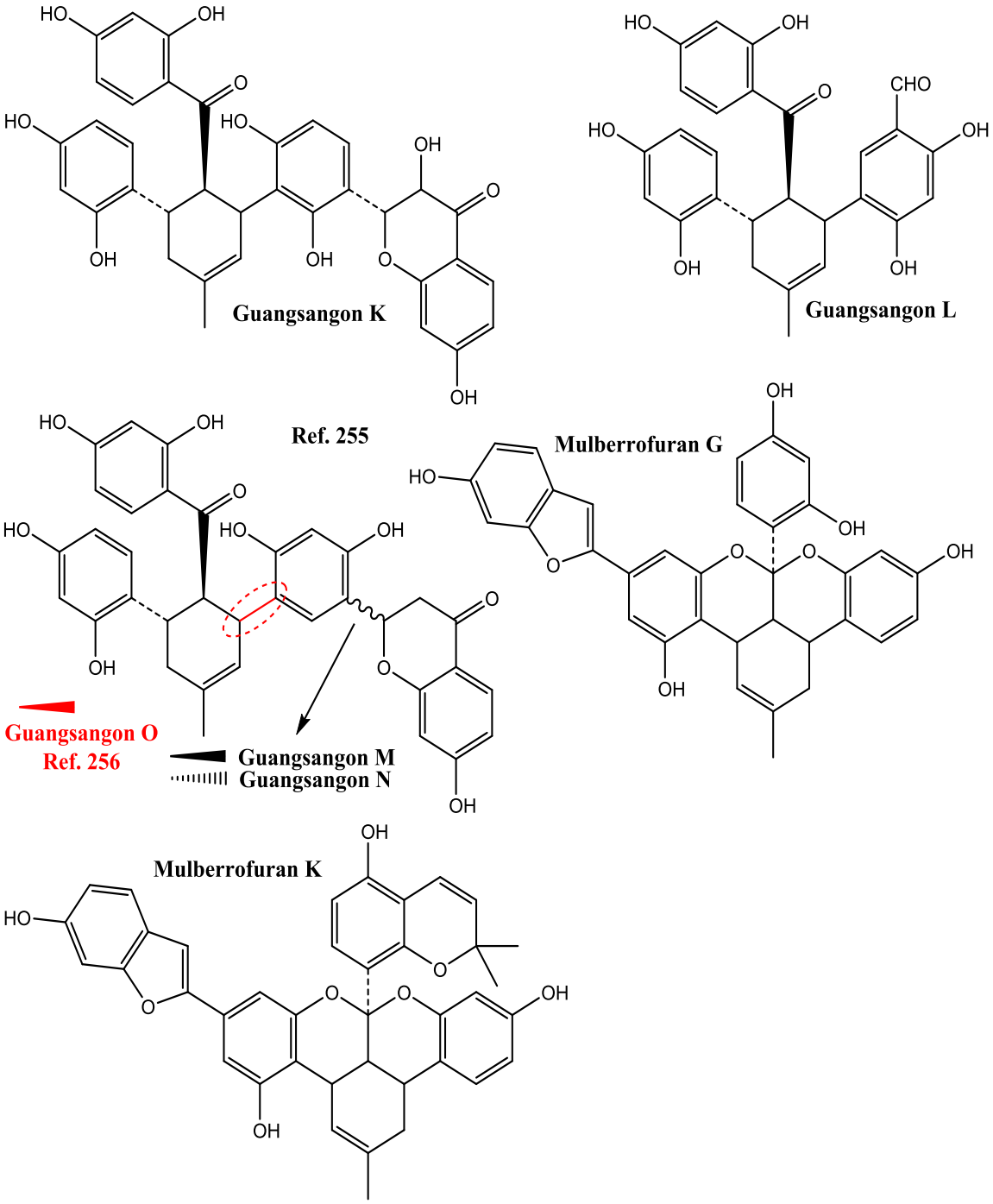


Figure 9B: Natural products isolated from *Morus macroura*.

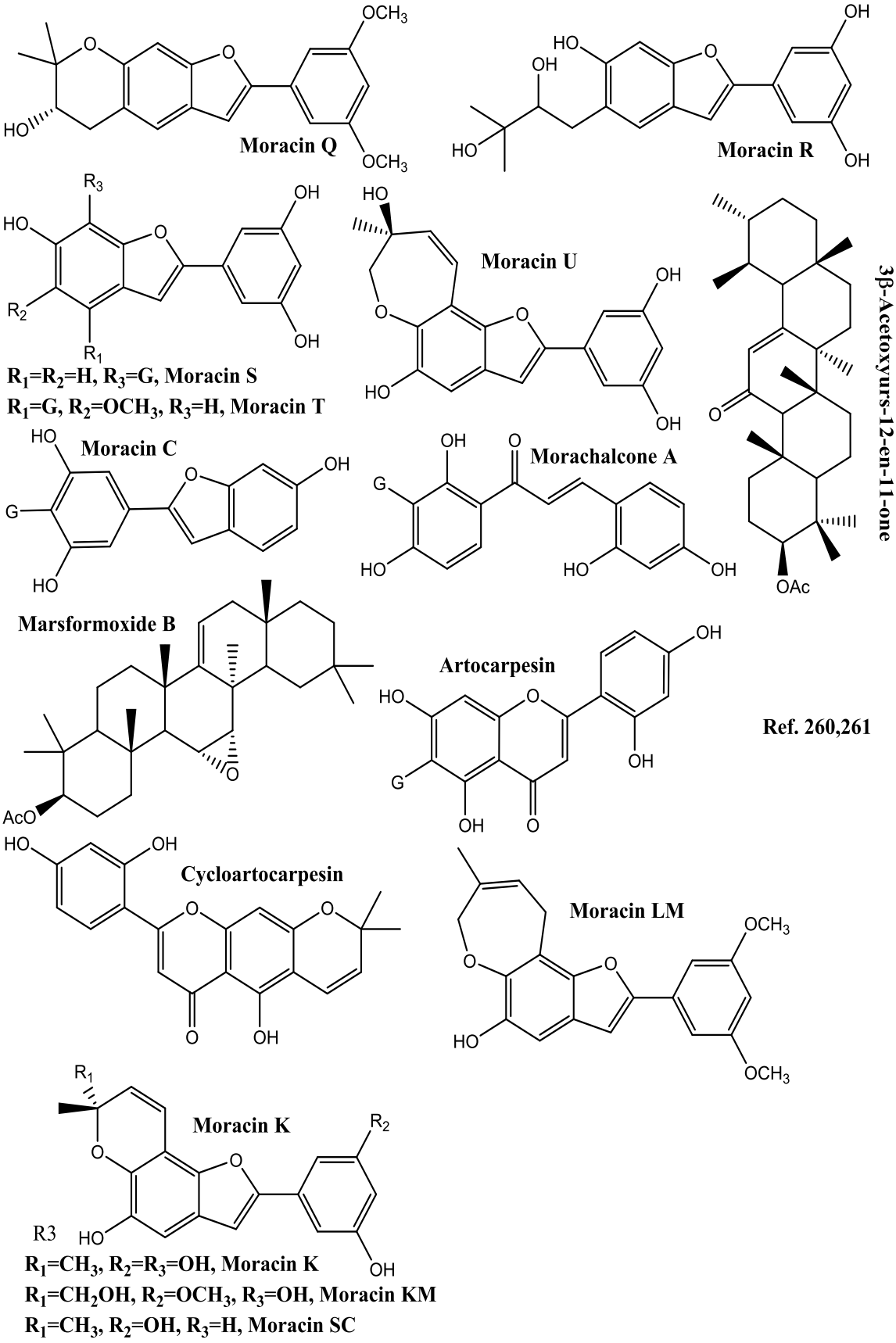


Figure 10: Natural products isolated from *Morus mesozygia.*

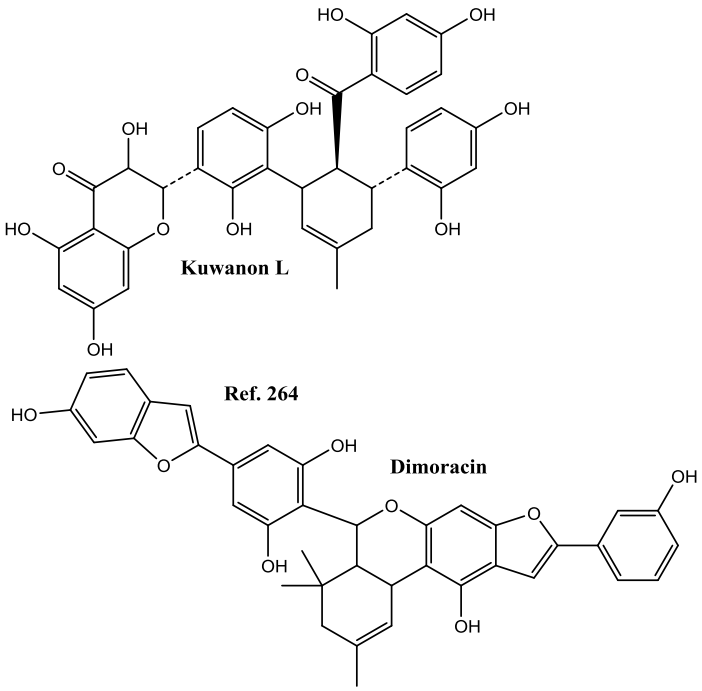


Figure 11A: Natural products isolated from *Morus mongolica.*

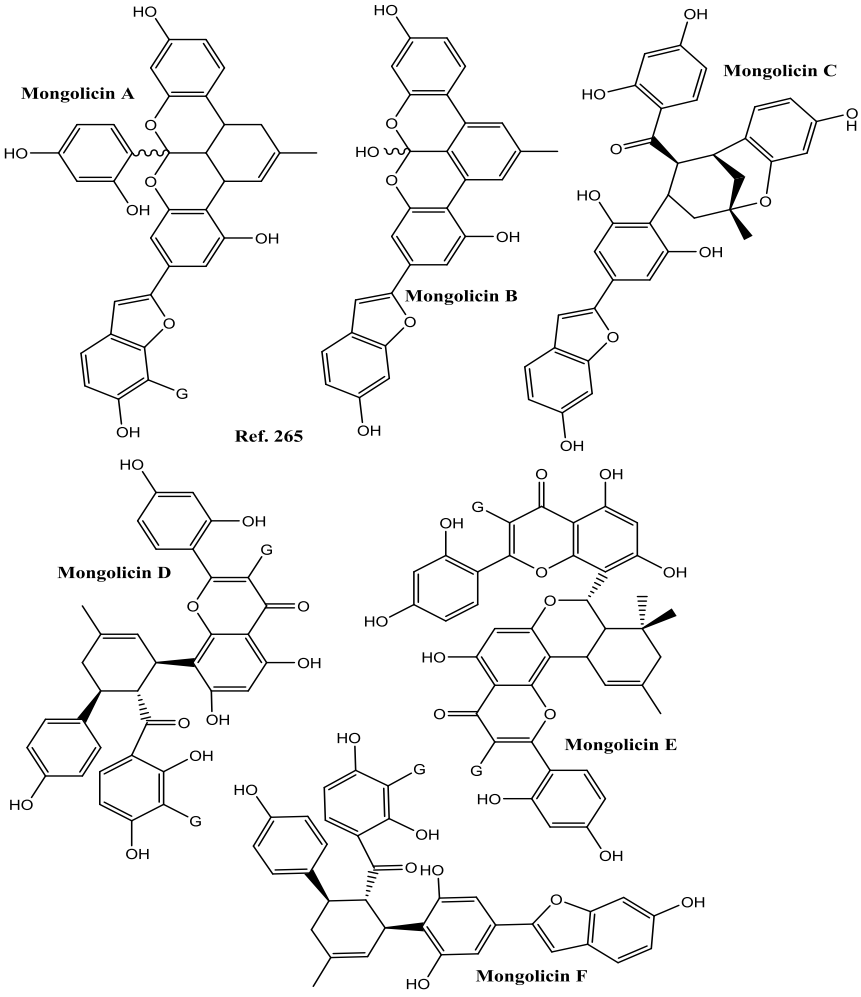


Figure 11B. Natural products isolated from *Morus mongolica.*

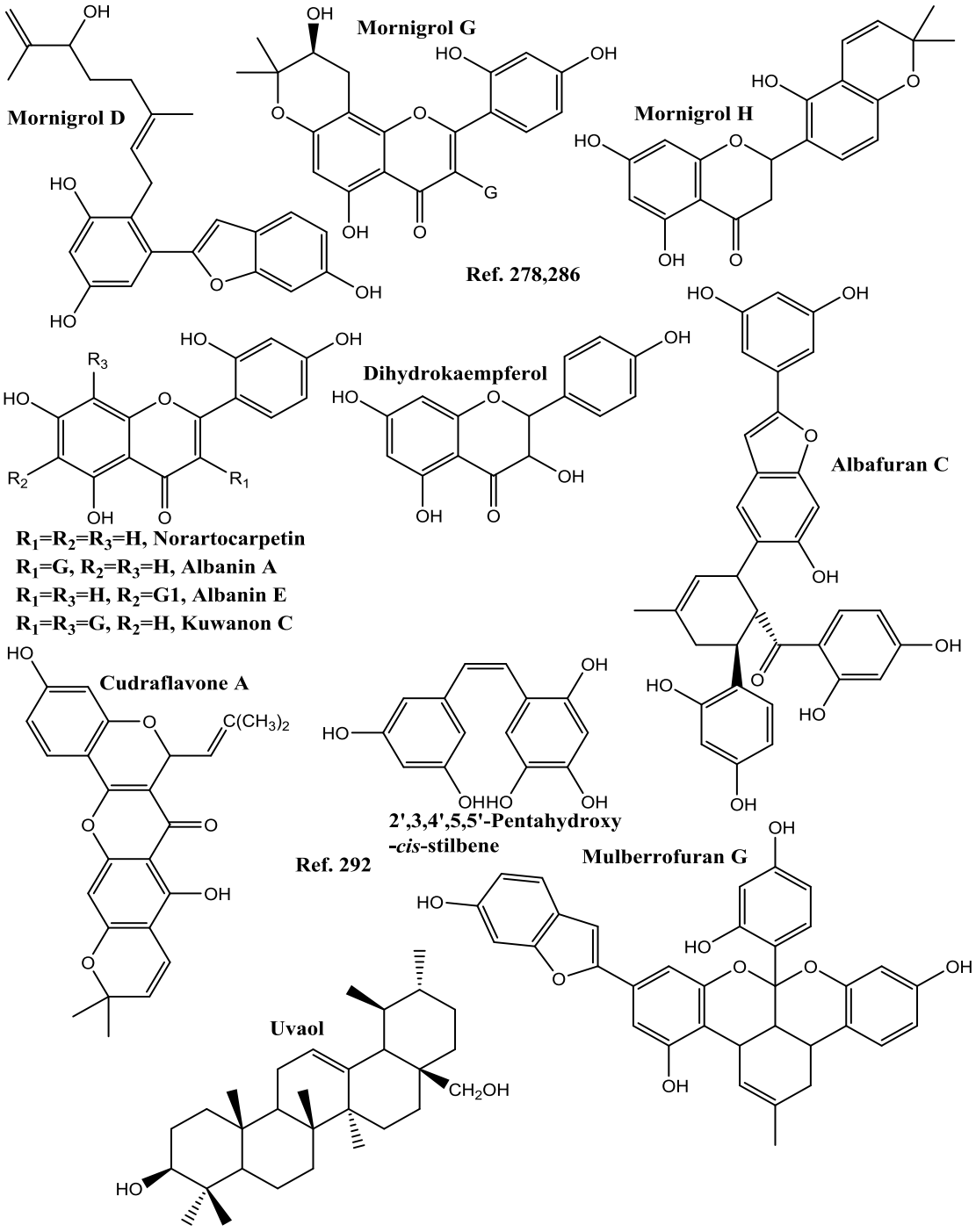


Figure 12A: Natural products isolated from *Morus nigra.*

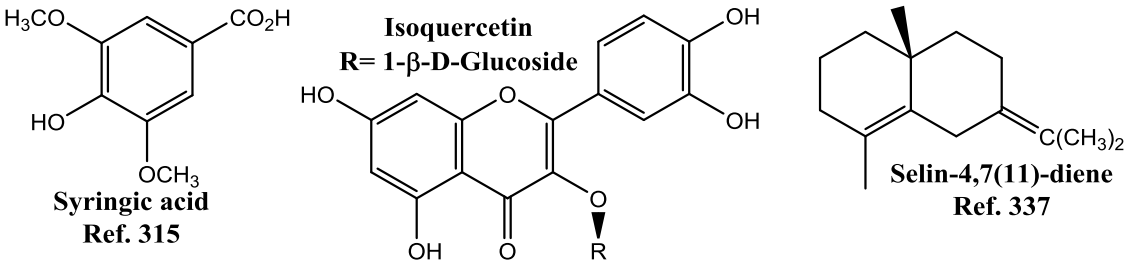


Figure 12B: Natural products isolated from *Morus nigra.*

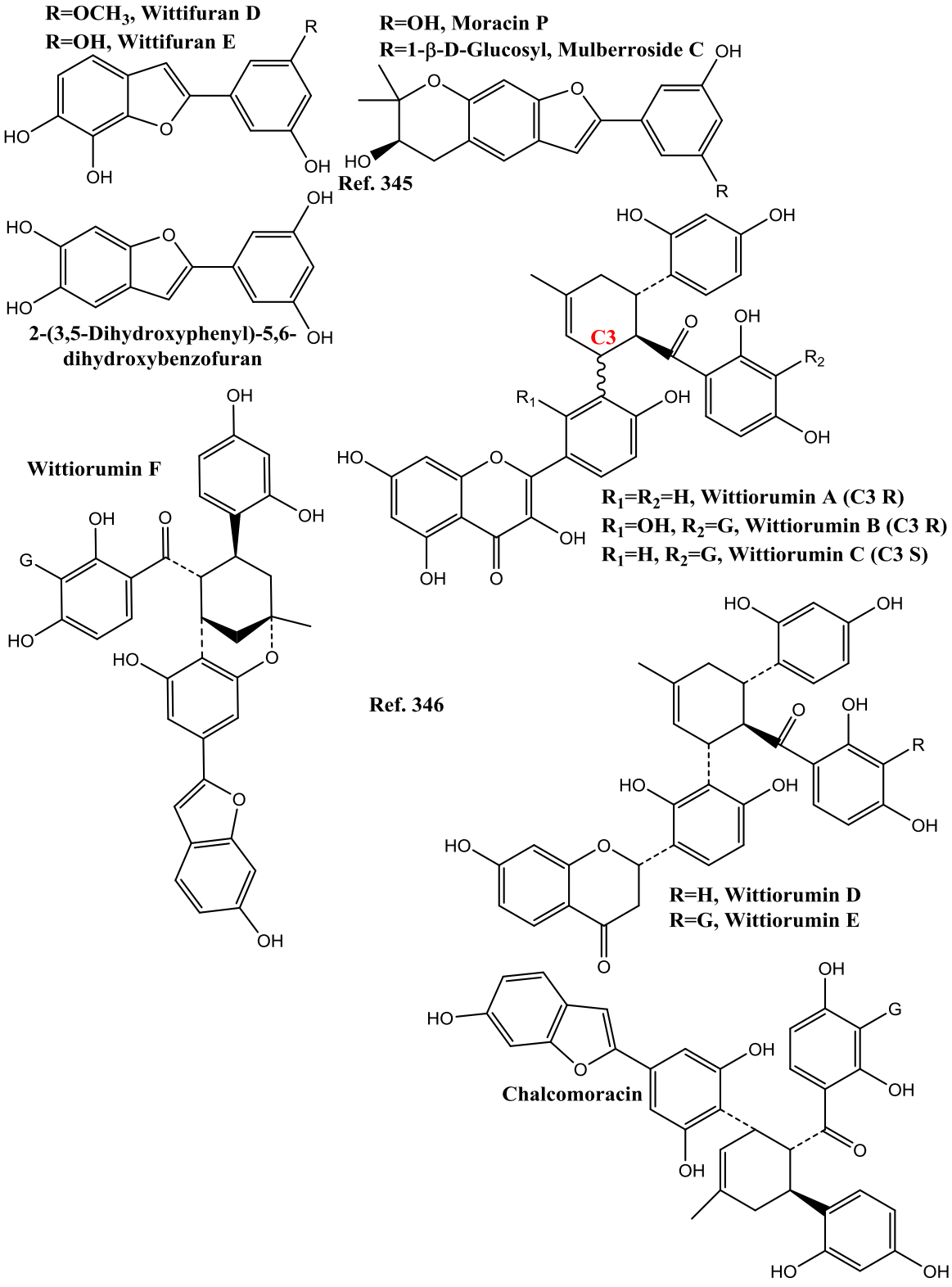


Figure 13A: Natural products isolated from *Morus wittiorum*.

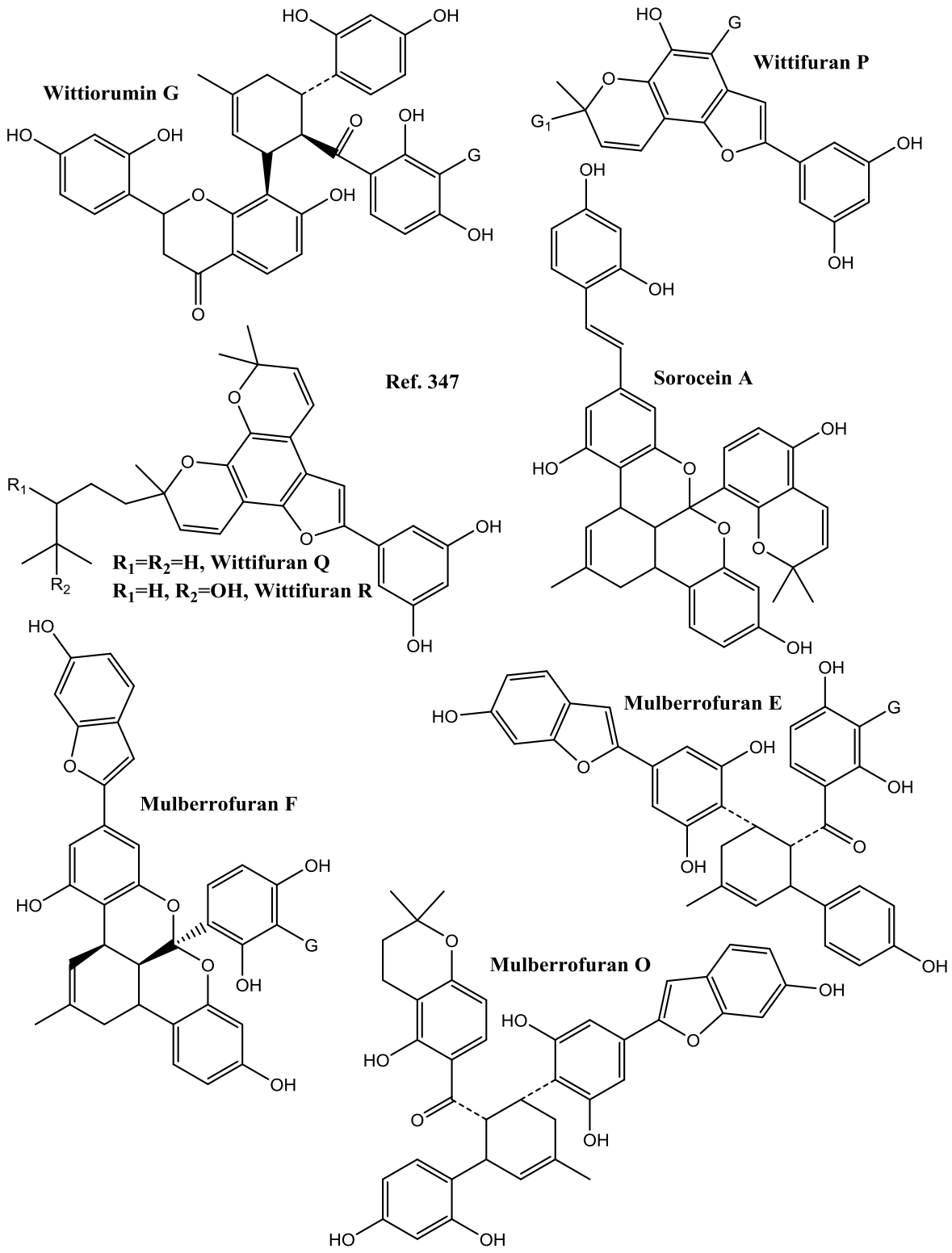


Figure 13B: Natural products isolated from *Morus wittiorum*.

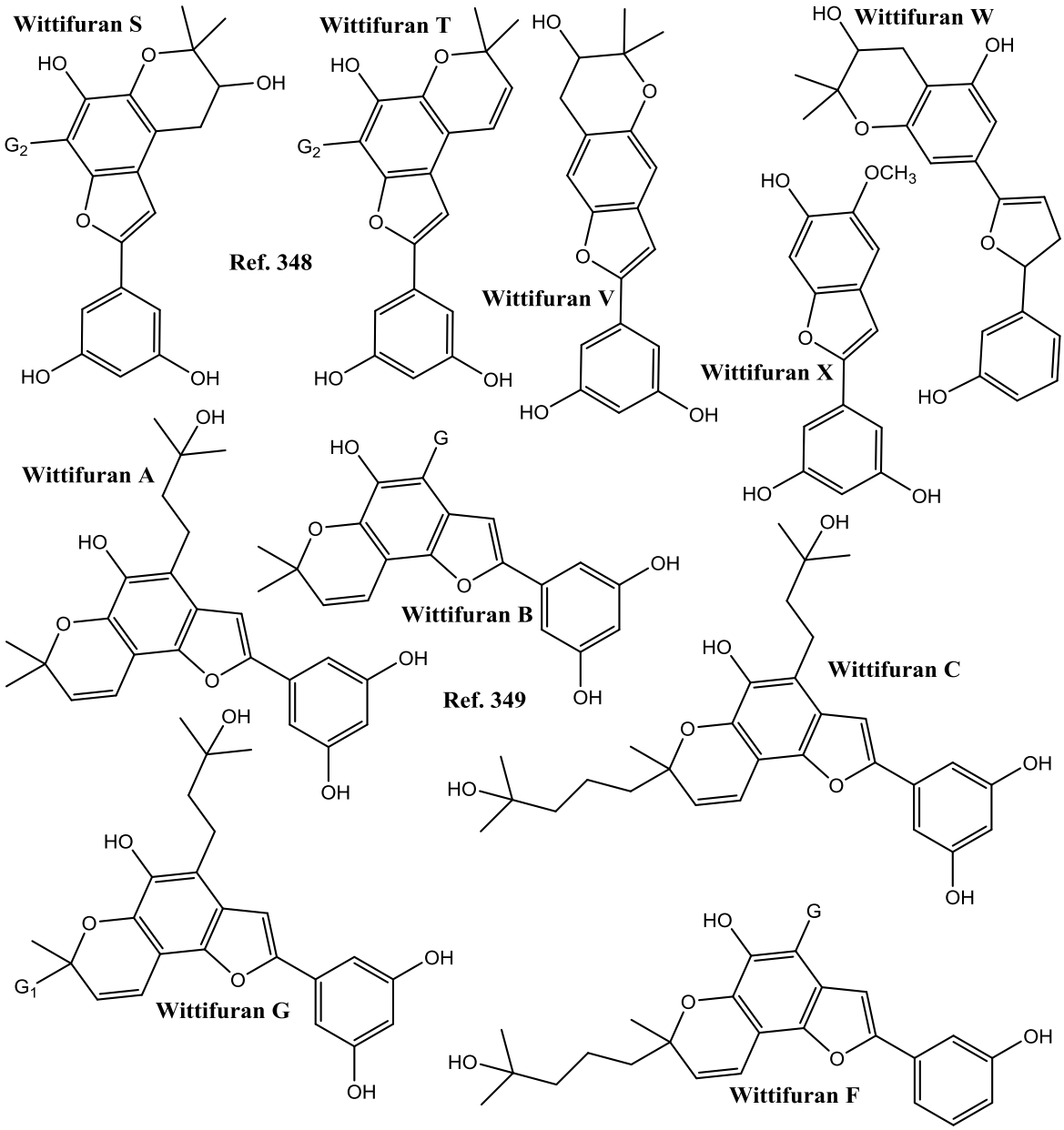


Figure 13C: Natural products isolated from *Morus wittiorum*.

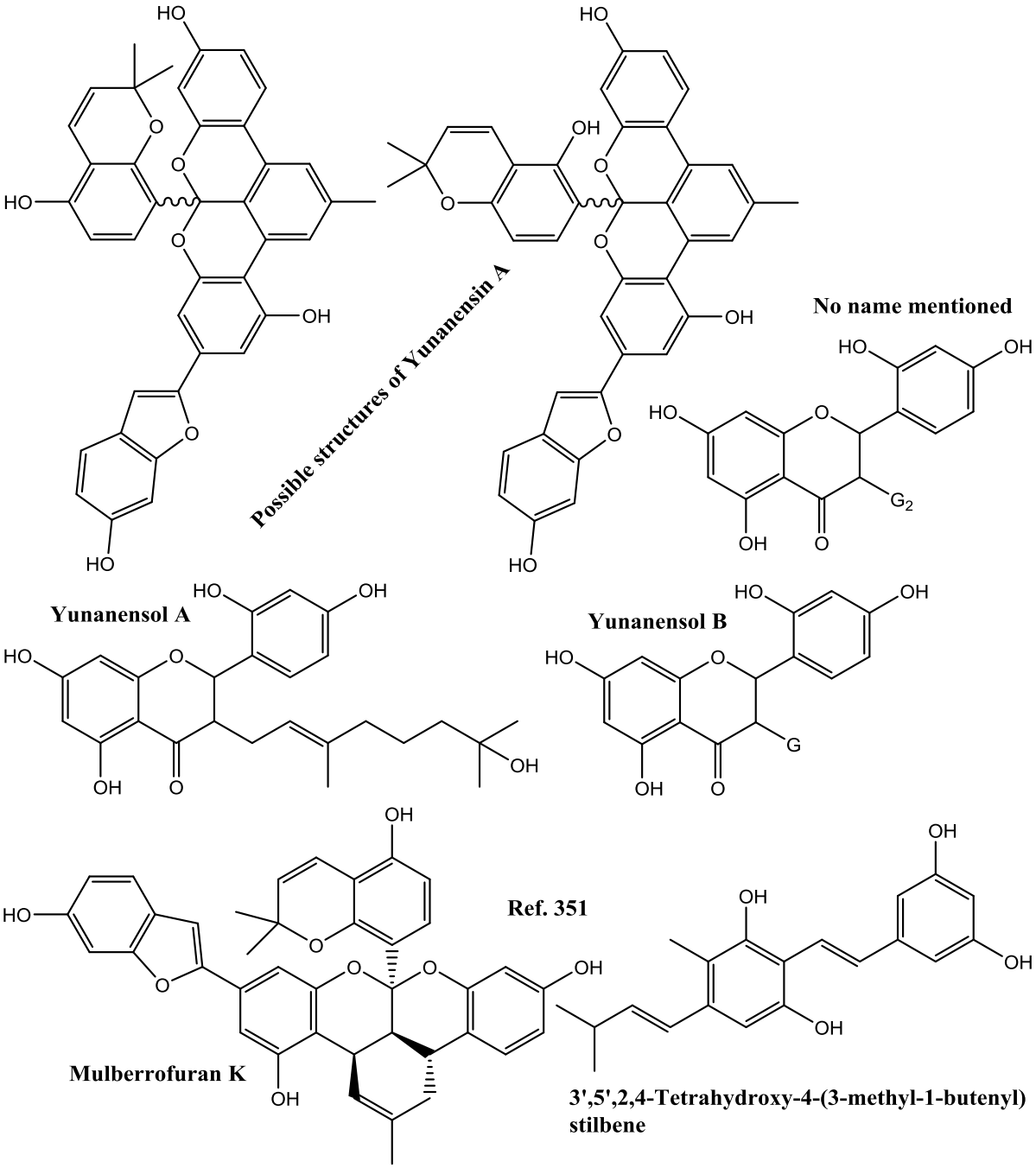


Figure 14: Natural products isolated from *Morus yunnanensis.*

4. DISCUSSION

Among all medicinal and other activities-properties, antioxidant is the most published of the species of *Morus* genus. And as shown in the previous section, *Morus alba* and *Morus nigra* are the most studied and most published. As for other properties activities, the active products of the plants, powders, extracts, oils and others, highly depend on their content of active natural products. Achieving best products depend on many variables and factors, where some are withing the researcher control (solvent, extraction conditions ... etc) while others are not.

Many publications present the influence of such factors on the outcome products and consequently their activities, and we presented some of them in the previous section. In **Table 2**, additional selected publications are summarized.

Table 2: Factors and Variables that Influence the Antioxidant Activity of *Morus* Species.

Author(s)	Main Findings	Ref.
A.R. Reddy ahc	Water deficit increases the activities of SOD, CAT, Ascorbate peroxidase and Peroxidase enzymes in *M. alba* leaves	[352]
J.J. Tan ahc	Effect of drying (50 or 100 °C oven, sun, air 24 °C) on the antioxidant activity of *M. alba* leaves	[353
Y. Xiaofeng ahc	Frost increases the accumulation of flavonol glycosides and the antioxidant activity of *M. alba* leaves	[354]
P.K. Bajpai ahc	Effect of locality on colour, active component and antioxidant capacity of *M. alba* fruits	[355]
J.Y. Hao ahc	Effect of locality on chemical composition, antioxidant and hypoglycemic activities of *M. alba* leaves	[356]
W. Zhu ahc	Comparison of metabolite contents and antioxidant activities of roots, leaves and branches of *M. alba*: roots were highest	[357]
J. Hu ahc	Effect of different light qualities of *M. alba* seedlings: physical, chlorophyl and SOD contents	[358]
A.K. Misra ahc	Water deficit increases photosynthesis, nitrate reductase activity and mass of *M. alba* leaves	[359]
Y. Lee, K.T. Hwang	Changes in *M. alba* fruits during ripening: anthocyanin content, antioxidant activity increased; DNJ and some others, decreased	[360]
N. Lu ahc	*M. alba* seedlings tolerate low to moderate salinity stress but the synthesis of enzymatic antioxidants is impaired in higher levels	[361]
F. Qin ahc	Application of zinc can alleviate lead stress in *M. alba* where alleviation is stronger in female than in male plants	[362]
C. Chen ahc	Effect of ripening stage of *M. alba* but mainly extraction solvents on extracts yields, active components and antioxidant capacity. Several solvents and many solutions were tested	[363]
Y. Yu ahc	Ultra-high pressure homogenisation processing of juice of *M. atropurpurea* reduced phenolic compounds, antioxidant capacity and α-glucosidase inhibition	[364]
F. Wang ahc	High pressure increased the content of active compounds and antioxidant activity of *M. atropurpurea* juice, while thermal treatment decreased them	[365]
A. Guha ahc	Examined the drought tolerance of *M. indica* by its structure and phytochemicals, including those responsible for antioxidation	[366]
O. Saracoglu	Phytochemicals accumulation and antioxidant capacity in *M. laevigata* change according to ripening stage	[367]
C.L. Nguyen, H.V. Nguyen	Ultrasonic and temperature effects on fruits mash of *M. rubra* before producing juice: increase of quantity and composition	[368]

Morus alba is undoubtedly the most studied and most published of all *Morus* species, and in addition to the previously cited publications, it is worth mentioning some others that are related to the topic of our review article.

C. Charunuch ahc reported adding leaves powder to snacks resulting improvement of texture, taste but mainly antioxidant capacity.[369] M. Przeor and N.M. Ahmed performed a similar study but for a more focused objective: healthy food for human diabetics.[370] E.J. Go ahc developed a new method of hot melt extrusion with which they prepared colloidal dispersion that increased the bioavailability of anthocyanins and had clear effect on probiotics and pathogenic microorganisms.[371] Q. Li ahc separately fermented juice using three different bacteria, and after optimization of the process, they achieved a successful method that enhanced the availability of active components, antioxidant capacity and α-glucosidase in inhibition.[372] M.A. Ammar fed rats with *M. alba* fruits and exposed them to γ-radiation.[373] She reported that compared with the control group that were irradiated but were not fed with fruits, the test group had higher levels of healthy biomarkers, including CAT, GSH, MDA, and SOD. J. Zhang ahc isolated a polysaccharide from the fruits and used to prepare a ferric chelate.[374] This proved to have high antioxidant activity, *in vitro* (hydroxyl radical and superoxide anion radical scavenging) and *in vivo* (supplemented to rats and showed MDA production inhibition). N.K. Lee ahc fermented leaves extract with *Lactobacillus plantarum*, resulting higher TPC, Kaempferol and Quercetin contents and antioxidant capacity, compared with the unfermented extract.[375]

S. Nasri ahc treated rats with 6-OHDA (6-Hydroxydopamine)-induced toxicity with *Morus nigra* leaves extract, resulting positive effect on several parameters, including oxidative stress biomarkers.[376] Captopril was reference drug in this study, and it was carried out as Parkinson's disease model. Y.K. Walia & D.K. Gupta developed an oxidation method of reducing sugars of *M. nigra*, using periodate, which can be useful for identification of these saccharides from plant material.[377] H.H. Lim ahc reported that soaking green coffee beans in *Morus bombycis* improved the qualities of the drinks prepared from these beans, especially the antioxidant capacity, verified with TFC, TPC and using FRAP method.[378] To conclude this part, it is worth mentioning that several publications reported the antioxidant and other properties of "Indian Mulberry", like the work of S.R. Deshmukh ahc.[379] But it is important to emphasize (authors did) that this species does not belong to the *Morus* genus, and its scientific name is *Morinda citrifolia*.

Numerous nanoparticles (NPs) were prepared and published using materials (especially aqueous extracts) originating from *Morus* species, and we have presented many of them in our previous review articles about this genus. However, in the present review article we will present only those with published antioxidant activity. A summary of selected publications is listed in **Table 3**.

Table 3: Selected Publications about NPs with Antioxidant Activity Prepared Using *Morus* Species Materials.

Author(s)	NPs; *Morus* Species and Plant Part; Major Activities	Ref.
D. Das ahc	Ag; *M. alba* leaf; Antioxidant, antimicrobial	[380]
A. Akbal ahc	Ag; *M. alba, M. nigra* leaf; Antioxidant	[381]
J. Sarah	Ag; *M. indica* fruit; Antioxidant, Antibacterial	[382]
H.B. Kim ahc	Ag; *M. alba* leaf; Antioxidant, Anticancer Antibacterial, Antidiabetic, Anti-inflammatory	[383]
I.R. Bunghez ahc	Ag; *M. nigra* fruit; Antioxidant	[384]
Y.N. Jeon ahc	Ag; *M. nigra* fruit; Antioxidant, Anticancer Antibacterial, Anti-inflammatory	[385]
O. Akmeşe ahc	Ag, Cu; *M. nigra* leaf; Antioxidant, Antimicrobial, Anticancer, Antidiabetic	[386]
K. Adavallan ahc	Au; *M. alba* leaf; Antioxidant, Antifungal	[387]
A. Singh ahc	CuO; *M. alba* leaf; Antioxidant for Plants Germination	[388]
Z. Amel ahc	CuO; *M. alba* leaf; Antioxidant, Antimicrobial, Photocatalytic	[389]
L.V. Rocha ahc	Se; *M. rubra* leaf; Antioxidant, Antimicrobial, Anticancer	[390]

Antioxidant or any other property-activity of a plant product (extract, oil, powder or others) is a result of the combined activities-properties of its components. So, in this last part of the discussion, antioxidant activity of selected natural products that were isolated from *Morus* species will be presented.

To start with, Albanol B (**Figure 5B**) induced production of ROS in cancer cells and suppresses their growth, reported T.N. Phan ahc.[391] Contrary to that, D-Fagomine (**Figure 15**), a DNJ analogue that was isolated from *Morus alba*[392], demonstrated clear antioxidant activity.

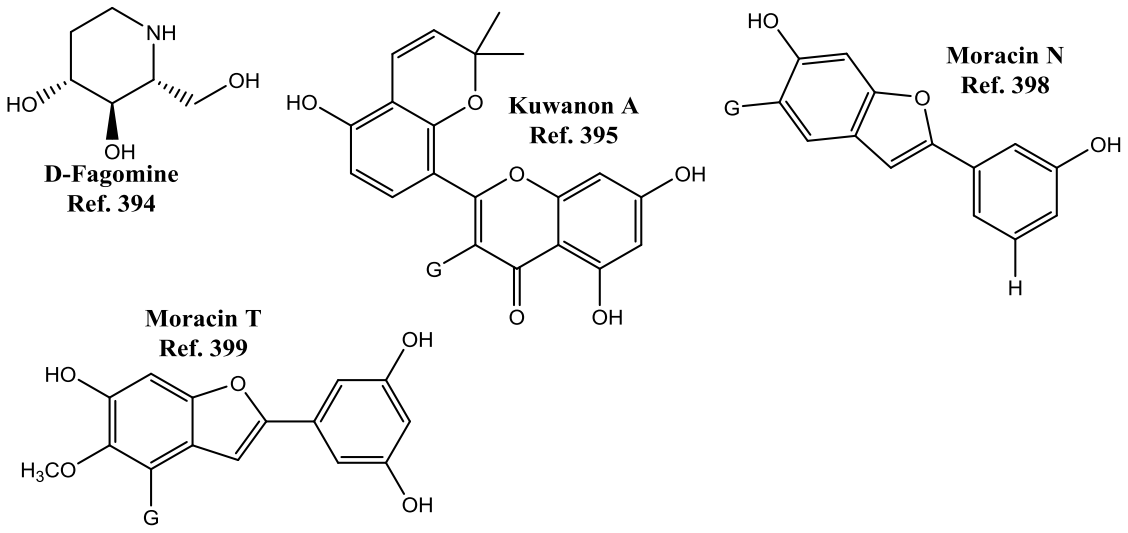


Figure 15: Natural Products with Antioxidant Activity Isolated from *Morus* Species.

C. Fang ahc reported that D-Fagomine attenuated oxidative stress induced by high glucose in endothelial cells[393], and L. Méndez ahc reported that combined supplementation of fish oil and D-Fagomine to rats prevents high-fat high-sucrose diet-induced prediabetes, by reducing oxidative stress.[394] Y. Liu ahc found that Kuwanon A (**Figure 15**) from *Morus alba* L. attenuates hydrogen peroxide-induced oxidative damage in HaCaT Keratinocytes, and they propose a mechanism of action.[395] P. Pothinuch & S. Tongchitpakdee elaborated on the antioxidant capacity of Melatonin (**Figure 3**), where they tested the effects of several parameters on the content of this compound in *Morus* leaf tea.[396]

Moracins are well known for their antioxidant capacity. Moracin M (**Figure 3**) was reported by S.G. Jagtap & V.B. Khyade for reducing hydrogen peroxide-induced oxidative stress in AH927 cells.[397] J. Tu ahc isolated Moracin N (**Figure 15**) from leaves of *Morus alba* and they reported that it has higher antioxidant capacity than Resveratrol.[398] H. Boulebd published a theoretical study of antioxidant capacity of Moracin T (**Figure 15**) against hydroxyl superoxide radical.[399]

Morusin (**Figure 3**) is one of the most potent natural products isolated from *Morus* species, and it has notably high antioxidant activity. X.L. Yin ahc reported that Morusin suppressed migration of A549 cancer cell through antioxidant activity (GSH, SOD), among other influencing factors.[400] This antioxidant activity of Morusin is one of the major reasons of the neuroprotective effect and against memory impairment induced by aluminium trichloride in rats, as it was reported by G. Gupta ahc.[401]

Finally, Oxyresveratrol (**Figure 5A**) is a superb antioxidant compound, and this capacity was mentioned in several review articles about this biologically very active natural product.[402] For this high quality of this compound, A.B. Sabater-Jara ahc published a research where they developed methods for increasing the production of Oxyresveratrol in *Morus alba*.[403]

5. CONCLUSIONS

1) *Morus* genus species have outstanding antioxidant potential.
2) Great part of this antioxidant capacity is due to phenolic compounds.
3) Some *Morus* species were sufficiently studied and published for antioxidant activity while others were limitedly published or not at all.
4) A research effort is needed to complete the understanding of the antioxidant capacity of all *Morus* species.
5) The antioxidant capacity of *Morus* species is utilized for human health but it can be way more beneficial.

6. REFERENCES

1. Azab A. Top edible wild plants of eastern Mediterranean region. Part V: antioxidant activity. *World J Pharm Res*., **2024;** *13:* 1821-1868. DOI: 10.20959/wjpr20241-30887
2. Dini I. Potential Health Benefits of Dietary Antioxidants. *Antioxidants*, **2026;** *15:* 92. DOI: 10.3390/antiox15010092
3. Lobo V, Patil A, Phatak A, Chandra N. Free radicals, antioxidants and functional foods: Impact on human health. *Pharmacogn Rev*., **2010;** *4:* 118-26. DOI: 10.4103/0973-7847.70902
4. Butt MS, Nazir A, Sultan MT, Schroën K. *Morus alba* L. nature's functional tonic. *Trends Food Sci Technol*, **2008;** *19:* 505-512. DOI: 10.1016/j.tifs.2008.06.002
5. Singh R, Bagachi A, Semwal A, Kaur S, Bharadwaj A. Traditional uses, phytochemistry and pharmacology of *Morus alba* Linn.: A review. *J Med Plants Res*., **2013;** *7:* 461-469. DOI:10.5897/JMPR012.1079
6. Zafar MS, Muhammad F, Javed I, Akhtar M, Khaliq T, Aslam B, Waheed A, Yasmin R, Zafar H. White mulberry (*Morus alba*): A brief phytochemical and pharmacological evaluations account. *Int J Agric Biol*., **2013;** *15:* 612-620. [ResearchGate]
7. Devi B, Sharma N, Kumar D, Jeet K. *Morus alba* Linn: A phytopharmacological review. *Int J Pharm Pharm Sci*., **2013;** *5:* 14-18. [ResearchGate]
8. Huang HP, Ou TT, Wang CJ. Mulberry (桑葚子 Sang Shèn Zǐ) and its bioactive

compounds, the chemoprevention effects and molecular mechanisms *in vitro* and *in vivo*. J Trad Complement Med., **2013;** *3:* 7-15. DOI: 10.4103/2225-4110.106535

9. Yang S, Wang BL, Li Y. Advances in the pharmacological study of *Morus alba* L. *Acta Pharm Sin*. (Yao Xue Xue Bao), **2014;** *49:* 824-831. [ResearchGate, article in Chinese]
10. Chan EW, Lye PY, Wong SK. Phytochemistry, pharmacology, and clinical trials of *Morus alba*. *Chin J Nat Med*., **2016;** *14:* 17-30. DOI: 10.3724/SP.J.1009.2016.00017
11. Gryn-Rynko A, Bazylak G, Olszewska-Slonina D. New potential phytotherapeutics obtained from white mulberry (*Morus alba* L.) leaves. *Biomed Pharmacother,* **2016;** *84:* 628-636. DOI: 10.1016/j.biopha.2016.09.081
12. Hussain F, Rana Z, Shafique H, Malik A, Hussain Z. Phytopharmacological potential of different species of *Morus alba* and their bioactive phytochemicals: A review. *Asian Pac J Trop Biomed*, **2017;** *7:* 950-956. DOI: 10.1016/j.apjtb.2017.09.015
13. Yuan Q, Zhao L. The Mulberry (*Morus Alba* L.) Fruit - A Review of Characteristic Components and Health Benefits. *J Agric Food Chem*., **2017;** *65:* 10383-10394. DOI: 10.1021/acs.jafc.7b03614
14. Rebai O, Belkhir M, Fattouch S, Amri M. Phytochemicals from mulberry extract (*Morus sp*.): Antioxidant and neuroprotective potentials. *J Appl Pharm Sci*., **2017;** *7:* 217-722. DOI: 10.7324/JAPS.2017.70133
15. Sanghi SB, Mushtaq S. Phyto-pharmacological activity of *Morus alba* Linn. Extracts–a review. *Asian J Pharm Sci*., **2017;** *6:* 10-19. [Journal website]
16. Zhang H, Ma ZF, Luo X, Li X. Effects of Mulberry Fruit (*Morus alba* L.) Consumption on Health Outcomes: A Mini-Review. *Antioxidants,* **2018;** *7:* 69. DOI: 10.3390/antiox7050069
17. Pujari AK, Devkar SR, Patil SS. Mulberry: A Medicinal Activity. *Eur J Pharm Med Res*., **2018;** *5:* 481-483. [Journal website]
18. Shahana S, Nikalje AP. Phytochemistry and bioactivity of (Mulberry) plant: A comprehensive review. *Asian J Pharm Pharmacol*, **2019;** *5:* 207-217. DOI: 10.31024/ajpp.2019.5.2.1
19. Kadam RA, Dhumal ND, Khyade VB. The Mulberry, *Morus alba* (L.): The Medicinal Herbal Source for Human Health. *Int J Curr Microbiol App Sci*., **2019;** *8:* 2941-2964. DOI: 10.20546/ijcmas.2019.804.341
20. Bajpai S, Rao AV, Muthukumaran M, Nagalakshmamma K. History and active pharmacokinetic principles of mulberry: a review. *IOSR J Pharm*., **2012;** *2:* 13-16. [ResearchGate]

21. Ullah R, Khan M, Shah SA, Saeed K, Kim MO. Natural Antioxidant Anthocyanins - A Hidden Therapeutic Candidate in Metabolic Disorders with Major Focus in Neurodegeneration. *Nutrients*, **2019;** *11:* 1195. DOI: 10.3390/nu11061195
22. Naik R, Harmalkar DS, Xu X, Jang K, Lee K. Bioactive benzofuran derivatives: moracins A-Z in medicinal chemistry. *Eur J Med Chem*., **2015;** *90:* 379-393. DOI: 10.1016/j.ejmech.2014.11.047
23. Meng X, Li Y, Li S, Zhou Y, Gan RY, Xu DP, Li HB. Dietary Sources and Bioactivities of Melatonin. *Nutrients*, **2017;** *9:* 367. DOI: 10.3390/nu9040367
24. Panek-Krzyśko A, Stompor-Gorący M. The Pro-Health Benefits of Morusin Administration - An Update Review. *Nutrients*, **2021;** *13:* 3043. DOI: 10.3390/nu13093043
25. Venkatesh KR, Chauhan S. Mulberry: Life enhancer. *J Med Plants Res*., **2008;** 2: 271-278. [ResearchGate]
26. Nomura T, Hano Y, Fukai T. Chemistry and biosynthesis of isoprenylated flavonoids from Japanese mulberry tree. *Proc Jpn Acad Ser B*., **2009;** *85:* 391-407. DOI: 10.2183/pjab.85.391
27. Priya S. Medicinal Values of Mulberry - An Overview. *J Pharm Res*., **2012;** *5:* 3588-3596. [Journal website]
28. Kostic DA, Dimitrijevic DS, Mitic SS, Mitic MN, Stojanovic GS, Zivanovic AV. A survey on macro- and micro-elements, phenolic compounds, biological activity and use of *Morus* spp. (Moraceae). *Fruits*, **2013;** *68:* 333–347. DOI: 10.1051/fruits/2013079
29. Miljković VM, Nikolić GS, Nikolić LB, Arsić BB. *Morus* species through centuries in pharmacy and as food. *Adv Technol*., **2014;** *3:* 111-115. DOI: 10.5937/savteh1402111M
30. Ramesh HL, Sivaram V, Murthy VN. Antioxidant and Medicinal Properties of Mulberry (*Morus Sp*.): A Review. *World J Pharm Res*., **2014;** *3:* 320-343. [ResearchGate]
31. Yang Y, Tan YX, Chen RY, Kang J. The latest reviewon the polyphenols and their bioactivities of Chinese Morus plants, *J Asian Nat Prod Res*., **2014;** *16:* 690-702, DOI: 10.1080/10286020.2014.923405
32. Wei H, Zhu JJ, Liu XQ, Feng WH, Wang ZM, Yan LH. Review of bioactive compounds from root barks of *Morus* plants (Sang-Bai-Pi) and their pharmacological effects. *Cogent Chem*., **2016;** *2:* 1212320. DOI: 10.1080/23312009.2016.1212320
33. Mahesh DS, Vidhathri BS, Vidyashree DN, Narayanaswamy TK, Subbarayappa CT, Muthuraju R. Biochemical Composition and Pharmacological Properties of Mulberry (*Morus* spp.) - A Review. *Int J Curr Microbiol App Sci*., **2017;** *6:* 2207-2217. DOI:

10.20546/ijcmas.2017.607.259

34. Aruna GR, Geetha MY, Manjunath G. Chemical composition and pharmacological functions and principles of mulberry: A Review. *Int J Appl Res*., **2017;** *3:* 251-254. [Journal website]
35. Thaipitakwong T, Numhom S, Aramwit P. Mulberry leaves and their potential effects against cardiometabolic risks: a review of chemical compositions, biological properties and clinical efficacy. *Pharm Biol*., **2018;** *56:* 109-118. DOI: 10.1080/13880209.2018.1424210
36. Jan N, Fatima T, Qadri T, Gani G, Naseer B, Hussain SZ. Pharmacological effects & quality parameters of *Morus* species: A review. *Int J Pharm Sci Res*., **2018;** *3:* 1-4. [ResearchGate]
37. Rodrigues EL, Marcelino G, Silva GT, Figueiredo PS, Garcez WS, Corsino J, Guimarães RCA, Freitas KC. Nutraceutical and Medicinal Potential of the *Morus* Species in Metabolic Dysfunctions. *Int J Mol Sci*., **2019;** *20:* 301. DOI: 10.3390/ijms20020301
38. Memete AR, Timar AV, Vuscan AN, Miere Groza F, Venter AC, Vicas SI. Phytochemical Composition of Different Botanical Parts of *Morus* Species, Health Benefits and Application in Food Industry. *Plants*., **2022;** *11:* 152. DOI: 10.3390/plants11020152
39. Tortora C, Pisano L, Vergine V, Ghirga F, Iazzetti A, Calcaterra A, Marković V, Botta B, Quaglio D. Synthesis, Biosynthesis, and Biological Activity of Diels-Alder Adducts from *Morus* Genus: An Update. *Molecules*, **2022;** *27:* 7580. DOI: 10.3390/molecules27217580
40. Chen J, Gou Z, Huang Y, Yu Q, Kim AN, Shi W, Zhou Y. Research Progress on Phytochemicals from Mulberry with Neuroprotective Effects: A Review. *Pharmaceuticals*, **2025;** *18:* 695. DOI: 10.3390/ph18050695
41. Bhati A, Boyina HK, Sharma N. Anti-Inflammatory and Antioxidant Mechanisms of Morus Species: Part-Specific Insights from Traditional Chinese Medicine. *Pharmacol Res Modern Chin Med*., **2026;** *18:* 100749. DOI: 10.1016/j.prmcm.2025.100749
42. Budiman A, Sulastri A, Tazyinul Qoriah A. Chemical compounds and pharmacological activity of *Morus nigra* as a potential product of drug: A review. *Int Res J Pharm*. **2018;** *9:* 76-81. DOI: 10.7897/2230-8407.09693
43. Khoerunnisa A, Kurniawansyah IS. A review: the natural antioxidant activity of black mulberry and its others function. *Farmaka*, **2018;** *16:* 353-364. [Journal website]
44. Lim SH, Choi CI. Pharmacological Properties of *Morus nigra* L. (Black Mulberry) as A

Promising Nutraceutical Resource. *Nutrients,* **2019;** *11:* 437. DOI: 10.3390/nu11020437

45. Yen GC, Wu SC, Duh PD. Extraction and identification of antioxidant components from the leaves of mulberry (*Morus alba* L.). *J Agric Food Chem*., *1996; 44:* 1687-1690. DOI: 10.1021/jf9503725
46. Doi K, Kojima T, Makino M, Kimura Y, Fujimoto Y. Studies on the constituents of the leaves of *Morus alba* L. Chem Pharm Bull., **2001;** 49: 151-153. DOI: 10.1248/cpb.49.151
47. Sudhakar C, Lakshmi A, Giridarakumar S. Changes in the antioxidant enzyme efficacy in two high yielding genotypes of mulberry (*Morus alba* L.) under NaCl salinity. *Plant Sci*., **2001;** *161:* 613-619. DOI: 10.1016/S0168-9452(01)00450-2
48. Oh H, Ko EK, Jun JY, Oh MH, Park SU, Kang KH, Lee HS, Kim YC. Hepatoprotective and free radical scavenging activities of prenylflavonoids, coumarin, and stilbene from *Morus alba*. *Planta Med*., **2002;** *68:* 932-934. DOI: 10.1055/s-2002-34930
49. Singab AN, El-Beshbishy HA, Yonekawa M, Nomura T, Fukai T. Hypoglycemic effect of Egyptian *Morus alba* root bark extract: effect on diabetes and lipid peroxidation of streptozotocin-induced diabetic rats. *J Ethnopharmacol,* **2005;** *100:* 333-338. DOI: 10.1016/j.jep.2005.03.013
50. Katsube T, Imawaka N, Kawano Y, Yamazaki Y, Shiwaku K, Yamane Y. Antioxidant flavonol glycosides in mulberry (*Morus alba* L.) leaves isolated based on LDL antioxidant activity. *Food Chem*., **2006;** *97:* 25-31. DOI: 10.1016/j.foodchem.2005.03.019
51. El-Beshbishy HA, Singab AN, Sinkkonen J, Pihlaja K. Hypolipidemic and antioxidant effects of *Morus alba* L. (Egyptian mulberry) root bark fractions supplementation in cholesterol-fed rats. *Life Sci*., **2006;** 78: 2724-2733. DOI: 10.1016/j.lfs.2005.10.010
52. Lee CY, Sim SM, Cheng HM. Systemic absorption of antioxidants from mulberry (*Morus alba* L) leaf extracts using an in situ rat intestinal preparation. *Nutrition Res*., **2007;** *27:* 492-497. DOI: 10.1016/j.nutres.2007.06.004
53. Liu LK, Lee HJ, Shih YW, Chyau CC, Wang CJ. Mulberry anthocyanin extracts inhibit LDL oxidation and macrophage-derived foam cell formation induced by oxidative LDL. *J Food Sci*., **2008;** *73:* 113-121. DOI: 10.1111/j.1750-3841.2008.00801.x
54. Gungor N, Sengul M. Antioxidant Activity, Total Phenolic Content and Selected Physicochemical Properties of White Mulberry (*Morus Alba* L.) Fruits. *Int J Food Prop*., **2008;** *11:* 44–52. DOI: 10.1080/10942910701558652
55. Chon SU, Kim YM, Park YJ, Heo BG, Park YS, Gorinstein S. Antioxidant and antiproliferative effects of methanol extracts from raw and fermented parts of mulberry

plant (*Morus alba* L.). *Eur Food Res Technol,* **2009;** *230:* 231-237. DOI: 10.1007/s00217-009-1165-2

56. Seddighara P, Berin A. Evaluation of the antioxidant activity of white mulberry leaf extract (*Morus alba* L). *J Med Herb, 2010; 5:* 43-46. [Journal website, article in Persian]
57. Bae MJ, Ye EJ. Antioxidant Activity and *in vitro* for Anticancer Effects of Manufactured Fermented Mulberry Leaf Tea. *J Korean Soc Food Sci*., **2010;** *39:* 796-804. DOI: 10.3746/jkfn.2010.39.6.796 [Article in Korean]
58. Aramwit P, Bang N, Srichana T. The properties and stability of anthocyanins in mulberry fruits. *Food Res Int*., **2010;** 43: 1093-1097. DOI: 10.1016/j.foodres.2010.01.022
59. Díaz M, Pérez Y, Cazaña Y, Prieto M, Wencomo H, Lugo Y. Determination of enzymatic antioxidants in *Morus alba* varieties and hybrids. *Pastos y Forrajes*, **2010;** *33:* 1-8. [Journal website, article in Spanish]
60. Nade VS, Kawale LA, Yadav AV. Protective effect of *Morus alba* leaves on haloperidol-induced orofacial dyskinesia and oxidative stress. *Pharm Biol*., **2010;** *48:* 17-22. DOI: 10.3109/13880200903029357
61. Yang X, Yang L, Zheng H. Hypolipidemic and antioxidant effects of mulberry (Morus alba L.) fruit in hyperlipidaemia rats. *Food Chem Toxicol,* **2010;** *48:* 2374-2379. DOI: 10.1016/j.fct.2010.05.074
62. Kim HG, Ju MS, Shim JS, Kim MC, Lee SH, Huh Y, Kim SY, Oh MS. Mulberry fruit protects dopaminergic neurons in toxin-induced Parkinson's disease models. *Br J Nutr*., **2010;** *104:* 8-16. DOI: 10.1017/S0007114510000218
63. Hussein MS, El-Tawil OS, Yassin NE, Abdou KA. The Protective Effect of *Morus Alba* and *Calendula Officinalis* Plant Extracts on Carbon Tetrachloride- Induced Hepatotoxicity in Isolated Rat Hepatocytes. *J Am Sci*., **2010;** *6:* 719-734. [Journal website]
64. Singab AN, Ayoub NA, Ali EN, Mostafa NM. Antioxidant and hepatoprotective activities of Egyptian moraceous plants against carbon tetrachloride-induced oxidative stress and liver damage in rats. *Pharm Biol*., **2010;** *48:* 1255-1264. DOI: 10.3109/13880201003730659
65. Kim GN, Jang HD. Flavonol content in the water extract of the mulberry (*Morus alba* L.) leaf and their antioxidant capacities. *J Food Sci*., **2011;** *76:* 869-873. DOI: 10.1111/j.1750-3841.2011.02262.x
66. Wanyo P, Siriamornpun S, Meeso N. Improvement of quality and antioxidant properties of dried mulberry leaves with combined far-infrared radiation and air convection in Thai

tea process. *Food Bioprod Process*, **2011;** *89:* 22-30. DOI: 10.1016/j.fbp.2010.03.005

67. Chang LW, Juang LJ, Wang BS, Wang MY, Tai HM, Hung WJ, Chen YJ, Huang MH. Antioxidant and antityrosinase activity of mulberry (*Morus alba* L.) twigs and root bark. *Food Chem Toxicol*, **2011;** *49:* 785-790. DOI: 10.1016/j.fct.2010.11.045
68. Zhang W, He J, Pan Q, Han F, Duan C. Separation and character analysis of anthocyanins from mulberry (*Morus alba* L.) pomace. *Czech J Food Sci*., **2011;** 29: 268-276. DOI: 10.17221/124/2008-CJFS
69. Bae HA, Baek H, Park HI, Choung MG, Sohn EH, Kim SH, Kim DS, Chung IM, Seong ES, Yu CY, Lim JD. Effect of fermentation time on the chemical composition of mulberry (*Morus alba* L.) leaf teas. *Korean J Med Crop Sci*., **2011;** *19:* 276–286. DOI: 10.7783/KJMCS.2011.19.4.276
70. Chan EW, Lye PY, Tan LN, Eng SY, Tan YP, Wong ZC. Effects of drying method and particle size on the antioxidant properties of leaves and teas of *Morus alba*, *Lagerstroemia speciosa* and *Thunbergia laurifolia*. *Chem Ind Chem Eng Quart, 2012; 18:* 465-472. DOI: 10.2298/CICEQ111116023C
71. Wang W, Zu Y, Fu Y, Efferth T. *In Vitro* Antioxidant and Antimicrobial Activity of Extracts from *Morus alba* L. Leaves, Stems and Fruits. *Am J Chin Med*., **2012;** *40:* 349-356. DOI: 10.1142/S0192415X12500279
72. Meselhy KM, Hammad LN, Farag N. Novel antisickling, antioxidant and cytotoxic prenylated flavonoids from the bark of *Morus alba* L. *Life Sci J*., **2012;** *9:* 830-841. [Google Scholar]
73. Yang JY, Lee HS. Evaluation of Antioxidant and Antibacterial Activities of Morin Isolated from Mulberry Fruits (*Morus alba* L.). *J Korean Soc Appl Biol Chem*., **2012;** 55: 485-489. DOI: 10.1007/s13765-012-2110-9
74. Zou Y, Liao S, Shen W, Liu F, Tang C, Chen CY, Sun Y. Phenolics and antioxidant activity of mulberry leaves depend on cultivar and harvest month in Southern China. *Int J Mol Sci*., **2012;** *13:* 16544-16553. DOI: 10.3390/ijms131216544
75. Hamzaa RG, Shahat AN, Mekawey HM. The Antioxidant Role of Mulberry (*Morus alba* L.) Fruits in Ameliorating the Oxidative Stress Induced in -Irradiated Male Rats. *Biochem Anal Biochem*, **2012;** *1:* 8. DOI: 10.4172/2161-1009.1000122
76. Nam S, Jang HW, Shibamoto T. Antioxidant activities of extracts from teas prepared from medicinal plants, *Morus alba* L., *Camellia sinensis* L., and *Cudrania tricuspidata*, and their volatile components. *J Agric Food Chem*., **2012;** *60:* 9097-9105. DOI: 10.1021/jf301800x

77. Madhumitha S, Indhuleka A. Cardioprotective effect of *Morus alba* L. leaves in isoprenaline induced rats. *Int J Pharm Sci Res*., **2012;** *3:* 1475-1480. DOI: 10.13040/IJPSR.0975-8232.3(5).1475-80
78. Kaewkaen P, Tong-Un T, Wattanathorn J, Muchimapura S, Kaewrueng W, Wongcharoenwanakit S. Mulberry Fruit Extract Protects against Memory Impairment and Hippocampal Damage in Animal Model of Vascular Dementia. *Evid Based Complement Alternat Med*., **2012;** 263520. DOI: 10.1155/2012/263520
79. Chen HD, Ding YQ, Yang SP, Li XC, Wang XJ, Zhang HY, Ferreira D, Yue JM. Morusalbanol A, a neuro-protective Diels–Alder adduct with an unprecedented architecture from *Morus alba*. *Tetrahedron,* **2012;** *68:* 6054-6058. DOI: 10.1016/j.tet.2012.05.017
80. Gug K. Physiological and Whitening Effects of Morus alba Extracts. *J Chosun Nat Sci*., **2012;** *5:* 46-52. DOI: 10.13160/ricns.2012.5.1.046
81. Liang L, Wu X, Zhu M, Zhao W, Li F, Zou Y, Yang L. Chemical composition, nutritional value, and antioxidant activities of eight mulberry cultivars from China. *Pharmacog Mag*., **2012;** *8:* 215-224. DOI: 10.4103/0973-1296.99287
82. Khan MA, Rahman AA, Islam S, Khandokhar P, Parvin S, Islam MB, Hossain M, Rashid M, Sadik G, Nasrin S, Mollah MN, Alam AH. A comparative study on the antioxidant activity of methanolic extracts from different parts of *Morus alba* L. (Moraceae). *BMC Res Notes*., **2013;** *6:* 24. DOI: 10.1186/1756-0500-6-24
83. Flaczyk E, Kobus-Cisowska J, Przeor M, Korczak J, Remiszewski M, Korbas E, Buchowski M. Chemical characterization and antioxidative properties of Polish variety of *Morus alba* L. leaf aqueous extracts from the laboratory and pilot-scale processes. *Agric Sci*., **2013;** *4:* 141-147. DOI: 10.4236/as.2013.45B026
84. Wang Y, Xiang L, Wang C, Tang C, He X. Antidiabetic and Antioxidant Effects and Phytochemicals of Mulberry Fruit (*Morus alba* L.) Polyphenol Enhanced Extract. *PLoS ONE*., **2013;** *8:* e71144. DOI: 10.1371/journal.pone.0071144
85. Ahmad A, Gupta G, Afzal M, Kazmi I, Anwar F. Antiulcer and antioxidant activities of a new steroid from *Morus alba*. *Life Sci*., **2013;** *92:* 202-210. DOI: 10.1016/j.lfs.2012.11.020
86. Kobus-Cisowska J, Gramza-Michalowska A, Kmiecik D, Flaczyk E, Korczak J. Mulberry fruit as an antioxidant component in muesli. *Agric Sci*., **2013;** *4:* 130-135. DOI: 10.4236/as.2013.45B024
87. Kim DS, Kang YM, Jin WY, Sung YY, Choi G, Kim HK. Antioxidant activities and

polyphenol content of *Morus alba* leaf extracts collected from varying regions. *Biomed Rep*., **2014;** *2:* 675-680. DOI: 10.3892/br.2014.294

88. Emniyet AA, Avci E, Ozcelik B, Avci GA, Kose DA. Antioxidant and Antimicrobial Activities with GC/MS Analysis of the *Morus alba* L. Leaves. *Hittite J Sci Eng*., **2014;** 137-141. DOI: 10.17350/HJSE19030000006
89. Bauomy AA, Dkhil MA, Diab MS, Amer OS, Zrieq RM, Al-Quraishy S. Response of spleen and jejunum of mice infected with *Schistosoma mansoni* to Mulberry treatment. *Pak J Zool*., **2014;** 46: 753-761. [Journal website]
90. Dimitrijevic DS, Kostic DA, Stojanovic GS, Mitic SS, Mitic MN, Dordevic AS. Phenolic composition, antioxidant activity, mineral content and antimicrobial activity of fresh fruit extracts of *Morus alba* L. *J Food Nutr Res*., **2014;** *53:* 22-30. [ResearchGate]
91. Kim YR, Lee JS, Lee KR, Kim YE, Baek NI, Hong EK. Effects of mulberry ethanol extracts on hydrogen peroxide-induced oxidative stress in pancreatic β-cells. *Int J Mol Med*., **2014;** *33:* 128-134. DOI: 10.3892/ijmm.2013.1534
92. Wang S, Fang M, Ma YL, Zhang YQ. Preparation of the Branch Bark Ethanol Extract in Mulberry *Morus alba*, Its Antioxidation, and Antihyperglycemic Activity *In Vivo*. *Evid Based Complement Alternat Med*., **2014;** 569652. DOI: 10.1155/2014/569652
93. Hajizadeh MR, Eftekhar E, Zal F, Jafarian A, Mostafavi-Pour Z. Mulberry leaf extract attenuates oxidative stress-mediated testosterone depletion in streptozotocin-induced diabetic rats. *Iran J Med Sci*., **2014;** *39:* 123-129. [PMID: 24644381]
94. Gupta SS, Kumar GR, Manju Sharma MS, Garima Pandey GP, Mohapatra PK, Rao CV. Effects of flavonoids from *Morus alba* leaves extract on experimentally induced gastroesophageal reflux disease (GERD) in rats. *Res J Pharm Biol Chem Sci*., **2014;** *5:* 1021-1030. [ResearchGate]
95. Dkhil MA, Al-Quraishy S, Delic D. The antioxidant and anti-herpes simplex viruses activity of *Morus alba* leaves extract. *Pak J Zool*., **2015;** *47:* 1563-1569. [ResearchGate]
96. Ghimeray AK, Jung US, Lee HY, Kim YH, Ryu EK, Chang MS. In vitro antioxidant, collagenase inhibition, and in vivo anti-wrinkle effects of combined formulation containing *Punica granatum*, *Ginkgo biloba*, *Ficus carica*, and *Morus alba* fruits extract. *Clin Cosmet Investig Dermatol*, **2015;** *8:* 389-396DOI: 10.2147/CCID.S80906
97. Dkhil MA, Bauomy AA, Diab MS, Al-Quraishy S. The Antioxidant Effect of *Morus alba* Leaves Extract on Kidney, Testes, Spleen and Intestine of Mice. *Pak J Zool*, **2015;** *47:* 393-397. [ResearchGate]
98. Ya W, Chun-Meng Z, Tao G, Yi-Lin Z, Ping Z. Preliminary screening of 44 plant extracts

for anti-tyrosinase and antioxidant activities. *Pak J Pharm Sci*., **2015;** *28:* 1737-1744. [ResearchGate]

99. Natić MM, Dabić DČ, Papetti A, Fotirić Akšić MM, Ognjanov V, Ljubojević M, Tešić Ž. Analysis and characterisation of phytochemicals in mulberry (*Morus alba* L.) fruits grown in Vojvodina, North Serbia. *Food Chem*., **2015;** *171:* 128-136. DOI: 10.1016/j.foodchem.2014.08.101
100. Seo KH, Lee DY, Jeong RH, Lee DS, Kim YE, Hong EK, Kim YC, Baek NI. Neuroprotective effect of prenylated arylbenzofuran and flavonoids from *Morus alba* fruits on glutamate-induced oxidative injury in HT22 hippocampal cells. *J Med Food*., **2015;** *18:* 403-408. DOI: 10.1089/jmf.2014.3196
101. Raman ST, Ganeshan AK, Chen C, Jin C, Li SH, Chen HJ, Gui Z. *In vitro* and *In vivo* Antioxidant Activity of Flavonoid Extracted from Mulberry Fruit (*Morus alba* L.). Pharmacog Mag., **2016;** 128-133. DOI: 10.4103/0973-1296.177910
102. Alam AK, Hossain AS, Khan MA, Kabir SR, Reza MA, Rahman MM, Islam MS, Rahman MA, Rashid M, Sadik MG. The Antioxidative Fraction of White Mulberry Induces Apoptosis through Regulation of p53 and NFκB in EAC Cells. *PLoS One*., **2016;** *11:* e0167536. DOI: 10.1371/journal.pone.0167536
103. Ranjan B, Kumar R, Verma N, Mittal S, Pakrasi PL, Kumar RV. Evaluation of antioxidant activity, phytochemical constituents and Anti-diabetic properties of C_{763} mulberry leaves. *J Biol Sci Med*., **2016;** *2:* 1-12. [ResearchGate]
104. Król E, Jeszka-Skowron M, Krejpcio Z, Flaczyk E, Wójciak RW. The Effects of Supplementary Mulberry Leaf (*Morus alba*) Extracts on the Trace Element Status (Fe, Zn and Cu) in Relation to Diabetes Management and Antioxidant Indices in Diabetic Rats. *Biol Trace Elem Res*., **2016;** *174:* 158-165. DOI: 10.1007/s12011-016-0696-1
105. Sande D, Solares MD, Rodríguez YE, Cabrera IC, Carballo LF, Pérezb NA, Moralesb YL, Colenc G, Takahashia JA. Roots from mulberries (*Morus alba*) natural and hybrids varieties: phenolic contend and nutraceutical potential as antioxidant. *J Appl Pharm Sci*., **2016;** *6:* 63-69. DOI: 10.7324/JAPS.2016.601110
106. Kujawska M, Ewertowska M, Adamska T, Ignatowicz E, Flaczyk E, Przeor M, Kurpik M, Liebert JJ. Protective Effect of Morus alba Leaf Extract on N-Nitrosodiethylamine-induced Hepatocarcinogenesis in Rats. *In vivo*., **2016;** *30:* 807-812. DOI: 10.21873/invivo.10998
107. Peanparkdee M, Iwamoto S, Borompichaichartkul C, Duangmal K, Yamauchi R. Microencapsulation of bioactive compounds from mulberry (*Morus alba* L.) leaf

extracts by protein–polysaccharide interactions. *Int J Food Sci Technol*, **2016;** *51:* 649-655. DOI: 10.1111/ijfs.13032

108. Ghareeb MA, Ahmed WS, Refahy LA, Abdou AM, Hamed MM, Abdel-Aziz MS. Isolation and characterization of the bioactive phenolic compounds from *Morus alba* leaves growing in Egypt. *Pharmacol Online*, **2016;** *3:* 157-167. [Journal website]
109. Oh NS, Lee JY, Joung JY, Kim KS, Shin YK, Lee KW, Kim SH, Oh S, Kim Y. Microbiological characterization and functionality of set-type yogurt fermented with potential prebiotic substrates *Cudrania tricuspidata* and *Morus alba* L. leaf extracts. *J Dairy Sci*., **2016;** *99:* 6014-6025. DOI: 10.3168/jds.2015-10814
110. Pham PP, Morales NP, Pitaksuteepong T, Hemstapat W. Antioxidant activity of mulberry stem extract: A potential used as supplement for oxidative stress-related diseases. *Songklanakarin J Sci Technol*, **2017;** *93:* 407-414. DOI: 10.14456/sjst-psu.2017.44
111. Li F, Zhang B, Chen G, Fu X. Analysis of solvent effects on polyphenols profile, antiproliferative and antioxidant activities of mulberry (*Morus alba* L.) extracts. *Int J Food Sci Technol*., **2017;** *52:* 1690-1698. DOI: 10.1111/ijfs.13443
112. Viloria MJ, Dulay RM, Waing KG. Biological activities *Morus alba* L. leaves (Alfonso variety). *Int J Biol Pharm All Sci*., **2017;** *6:* 1629-1636. [Journal website]
113. Raj A, Mruthunjaya K, Madhunapantula SR, Manjula SN. Comparative Assessment of the Anti-oxidant and Anti-clastogenic Activity of *Morus alba* Leaves. *Free Radic Antioxid*, **2017;** *7:* 123-127. DOI: 10.5530/fra.2017.1.18
114. Jeszka-Skowron M, Flaczyk E, Podgórski T. In vitro and in vivo analyses of *Morus alba* Polish var. wielkolistna zolwinska leaf ethanol–water extract—antioxidant and hypocholesterolemic activities in hyperlipideamic rats. *Eur J Lipid Sci Technol*, **2017;** *119:* 1600514. DOI: 10.1002/ejlt.201600514
115. Alanazi AS, Anwar MJ, Alam MN. Hypoglycemic and Antioxidant Effect of *Morus alba* L. Stem Bark Extracts in Streptozotocin-Induced Diabetes in Rats. *J Appl Pharm*, **2017;** *9:* 234. DOI: 10.21065/1920-4159.1000234
116. Liao BY, Zhu DY, Thakur K, Li L, Zhang JG, Wei ZJ. Thermal and Antioxidant Properties of Polysaccharides Sequentially Extracted from Mulberry Leaves (*Morus alba* L.). *Molecules*, **2017;** *22:* 2271. DOI: 10.3390/molecules22122271
117. Anwar E, Djajadisasra J, Mardliyati E. The study of antioxidant and antityrosinase activity of extract from mulberry root (*Morus alba* L.). *J Pharm Sci Res*., **2017;** *9:* 2004-2008. [ResearchGate]

118. Xu J, Wang X, Cao K, Dong Z, Feng Z, Liu J. Combination of β-glucan and *Morus alba* L. Leaf Extract Promotes Metabolic Benefits in Mice Fed a High-Fat Diet. *Nutrients*, **2017;** *9:* 1110. DOI: 10.3390/nu9101110
119. Singh A, Dar MY, Sharma A, Sharma S, Shrivastava S, Shukla S. Therapeutic efficacy of *Morus alba* L. against N-nitrosodiethylamine induced subchronic hepatic ailment in rats. *Toxicol Environ Health Sci*., **2017;** *9:* 177-187. DOI: 10.1007/s13530-017-0319-z
120. Salama AA, Ibrahim BM, Yassin NA, Mahmoud SS, Gamal El-Din AA, Shaffie NA. Regulatory effects of *Morus alba* aqueous leaf extract in streptozotocin-induced diabetic nephropathy. *Der Pharma Chem*., **2017;** *9:* 46-52. [Journal website]
121. Guo XX, Liu J, Zhang H, Ji BP, Zhou F. Addition of mulberry leaf (*Morus Alba* L.) to a diet formula impeded its hypoglycemic effect and exacerbated dyslipidemia in high-fructose-and high-fat-induced CD-1 mice. *Emir J Food Agric*, **2017;** *29:* 532-538. DOI: 10.9755/ejfa.2017-05-1067
122. Rebai O, Belkhir M, Boujelben A, Fattouch S, Amri M. *Morus alba* leaf extract mediates neuroprotection against glyphosate-induced toxicity and biochemical alterations in the brain. *Environ Sci Pollut Res Int*., **2017;** *24:* 9605-9613. DOI: 10.1007/s11356-017-8584-6
123. Wang B, Gupta G, Singh M, Veerabhadrappa KV, Mishra A, Chinnaboina GK. Pharmacological evaluation of novel flavone from *Morus alba* in pentylenetetrazole-induced kindling and oxidative stress. *J Environ Pathol Toxicol Oncol*., **2018;** *37:* 43-52. DOI: 10.1615/JEnvironPatholToxicolOncol.v36.i1.
124. Jha S, Gupta SK, Bhattacharyya P, Ghosh A, Mandal P. *In vitro* antioxidant and antidiabetic activity of oligopeptides derived from different mulberry (*Morus alba L.*) cultivars. *Pharmacog Res*., 2018; *10:* 361-367. DOI: 10.4103/pr.pr_70_18
125. Akyurt B, Başyiğit B, Çam M. Phenolic compounds content, antioxidant and antidiabetic potentials of seven edible leaves. *GIDA J Food*., **2018;** *43:* 876-885. DOI: 10.15237/gida.GD18076
126. Ganzon JG, Chen LG, Wang CC. 4-*O*-Caffeoylquinic acid as an antioxidant marker for mulberry leaves rich in phenolic compounds. *J Food Drug Anal*., **2018;** *26:* 985-993. DOI: 10.1016/j.jfda.2017.11.011
127. Wang B, Yang CT, Diao QY, Tu Y. The influence of mulberry leaf flavonoids and Candida tropicalis on antioxidant function and gastrointestinal development of preweaning calves challenged with Escherichia coli O141:K99. *J Dairy Sci*., **2018;** *101:* 6098-6108. DOI: 10.3168/jds.2017-13957

128. Jantwal C, Srivastava S, Srivastava RP. Nutritional Quality and Antioxidant Activity of Leaves of Six Mulberry Genotypes. *Indian J Nutr Dietetics*, **2018;** *55:* 142-155. DOI: 10.21048/ijnd.2018.55.2.18141
129. Liu C, Zhu R, Liu H, Li L, Chen B, Jia Q, Wang L, Ma R, Tian S, Wang M, Fu M, Niu J, Orekhov AN, Gao S, Zhang D, Zhao B. Aqueous Extract of *Mori Folium* Exerts Bone Protective Effect Through Regulation of Calcium and Redox Homeostasis via PTH/VDR/CaBP and AGEs/RAGE/Nox4/NF-κB Signaling in Diabetic Rats. *Front Pharmacol*, **2018;** *9:* 1239. DOI: 10.3389/fphar.2018.01239
130. Zhao JG, Zhang YQ. A novel estimation method of total flavonoids in edible medicinal mulberry leaves by ultrasound-assisted hydroalcohol-acid extraction and HPLC-DAD. *J Appl Bot Food Qual*, **2018;** *91:* 114-119. DOI: 10.5073/JABFQ.2018.091.016
131. Yimam M, Talbott SM, Talbott JA, Brownell L, Jia Q. AmLexin, a Standardized blend of *Acacia catechu* and *Morus alba*, shows benefits to delayed onset muscle soreness in healthy runners. *J Exerc Nutrition Biochem*, **2018;** *22:* 20-31. DOI: 10.20463/jenb.2018.0027
132. Zhu ZE, Jiang JJ, Jie YU, Bing YU. Effect of dietary supplementation with mulberry (*Morus alba* L.) leaves on the growth performance, meat quality and antioxidative capacity of finishing pigs. *J Integrat Agric*., **2019;** *18:* 143-151. DOI: 10.1016/S2095-3119(18)62072-6
133. Cui H, Lu T, Wang M, Zou X, Zhang Y, Yang X, Dong Y, Zhou H. Flavonoids from *Morus alba* L. Leaves: Optimization of Extraction by Response Surface Methodology and Comprehensive Evaluation of Their Antioxidant, Antimicrobial, and Inhibition of α-Amylase Activities through Analytical Hierarchy Process. *Molecules*, **2019;** *24:* 2398. DOI: 10.3390/molecules24132398
134. Burhan A, Awaluddin A, Zulham BT, Gafur A. Antioxidant and anticancer activities of murbei (*Morus alba* L.) stem extract on in vitro widr cancer cells. *J Farm Sains Komun*, **2019;** *16:* 63-67. DOI: 10.24071/jpsc.001698
135. Srivastava NS, Dixit D. Antioxidant and anti-aging properties of aqueous and methanolic extracts of *Morus alba* (white mulberry) leaves. *World J Pharm Pharm Sci*., **2019;** *8:* 1103-1112. DOI: 10.20959/wjpps20195-13737
136. Polumackanycz M, Sledzinski T, Goyke E, Wesolowski M, Viapiana A. A Comparative Study on the Phenolic Composition and Biological Activities of *Morus alba* L. Commercial Samples. *Molecules*, **2019;** *24:* 3082. DOI: 10.3390/molecules24173082
137. Wang PP, Huang Q, Chen C, You LJ, Liu RH, Luo ZG, Zhao MM, Fu X. The chemical

structure and biological activities of a novel polysaccharide obtained from *Fructus Mori* and its zinc derivative. *J Funct Foods*, **2019;** *54:* 64-73. DOI: 10.1016/j.jff.2019.01.008

138. Tongmai J, Chupeeruch C, Suttisansanee U, Chamchan R, Khemthong C, On-Nom N. Development of anthocyanin-rich jelly by Thai mulberry (*Morus alba*) fruit powder. *Walailak Proc*., **2019;** IC4IR-68. [Semantic Scholar]
139. Przygonski K, Wojtowicz E. The optimization of extraction process of white mulberry leaves and the characteristic bioactive properties its powder extract. *Herba Pol*., **2019;** *65:* 12-19. DOI: 10.2478/hepo-2019-0003
140. Park S, Zhang T, Qiu JY, Wu X. The Combination of Mulberry Extracts and Silk Amino Acids Alleviated High Fat Diet-Induced Nonalcoholic Hepatic Steatosis by Improving Hepatic Insulin Signaling and Normalizing Gut Microbiome Dysbiosis in Rats. *Evid Based Complement Alternat Med*., **2019;** 8063121. DOI: 10.1155/2019/8063121
141. Hashim MI, Askar SJ. Ameliorating Effects of *Morus alba* Leaves Extract on Nephrotoxicity - Induced by Gentamicin in Male Rats. *Indian J Nat Sci*., **2019;** *9:* 16626-16637. [ResearchGate]
142. Raj AN, Dey SU, Rao S, Madhunapantula V, Manjula SN. Neuroprotective And Cognitive Enhancing Effect Of Methanolic *Morus alba* Leaf Fraction In U87mg Cell Lines And Experimental Rat Model. *Asian J. Pharm. Clin. Res*., **2019;** *12:* 238-243. DOI: 10.22159/ajpcr.2019.v12i4.32359
143. Ustun-Argon Z, İlhan N, Gökyer A, Büyükhelvacıgil-Öztürk S, Koparal B. Phytochemical Evaluation of *Morus alba* Seeds and Cold Pressed Oil. *J Turk Chem Soc Chem A*., **2019;** *6:* 41-50. DOI: 10.18596/jotcsa.470279
144. Bauomy AA. The potential role of *Morus alba* leaves extract on the brain of mice infected with *Schistosoma mansoni*. *CNS Neurol Disord Drug Targets*, **2014;** *13:* 1513-1519. DOI: 10.2174/1871527313666140806120717
145. Przeor M, Flaczyk E, Kmiecik D, Buchowski MS, Staniek H, Tomczak-Graczyk A, Kobus-Cisowska J, Gramza-Michałowska A, Foksowicz-Flaczyk J. Functional Properties and Antioxidant Activity of *Morus alba* L. Leaves var. Zolwinska Wielkolistna (WML-P)-The Effect of Controlled Conditioning Process. *Antioxidants*, **2020;** *9:* 668. DOI: 10.3390/antiox9080668
146. Ghavami G, Muhammadnejad S, Amanpour S, Sardari S. Bioactivity Screening of Mulberry Leaf Extracts and two Related Flavonoids in Combination with Cisplatin on Human Gastric Adenocarcinoma Cells. *Iranian J Pharm Res*., **2020;** *19:* 371-382. DOI:

10.22037/ijpr.2020.1101087

147. Leyva-Jiménez FJ, Ruiz-Malagón AJ, Molina-Tijeras JA, Diez-Echave P, Vezza T, Hidalgo-García L, Lozano-Sánchez J, Arráez-Román D, Cenis JL, Lozano-Pérez AA, Rodríguez-Nogales A, Segura-Carretero A, Gálvez J. Comparative Study of the Antioxidant and Anti-Inflammatory Effects of Leaf Extracts from Four Different *Morus alba* Genotypes in High Fat Diet-Induced Obesity in Mice. **Antioxidants, 2020;** *9:* 733. DOI: 10.3390/antiox9080733
148. Bayazid AB, Kim JG, Park SH, Lim BO. Antioxidant, anti-inflammatory, and antiproliferative activity of *Mori Cortex Radicis* extracts. *Nat Prod Commun,* **2020;** *15:* 1-8. DOI: 10.1177/1934578X19899765
149. Temviriyanukul P, Sritalahareuthai V, Jom KN, Jongruaysup B, Tabtimsri S, Pruesapan K, Thangsiri S, Inthachat W, Siriwan D, Charoenkiatkul S, Suttisansanee U. Comparison of Phytochemicals, Antioxidant, and In Vitro Anti-Alzheimer Properties of Twenty-Seven *Morus* spp. Cultivated in Thailand. *Molecules,* **2020;** *25:* 2600. DOI: 10.3390/molecules25112600
150. Tomczyk M, Miłek M, Sidor E, Kapusta I, Litwińczuk W, Puchalski C, Dżugan M. The Effect of Adding the Leaves and Fruits of *Morus alba* to Rape Honey on Its Antioxidant Properties, Polyphenolic Profile, and Amylase Activity. *Molecules,* **2020;** *25:* 84. DOI: 10.3390/molecules25010084
151. Chaiyana W, Sirithunyalug J, Somwongin S, Punyoyai C, Laothaweerungsawat N, Marsup P, Neimkhum W, Yawootti A. Enhancement of the Antioxidant, Anti-Tyrosinase, and Anti-Hyaluronidase Activity of *Morus alba* L. Leaf Extract by Pulsed Electric Field Extraction. *Molecules,* **2020;** *25:* 2212. DOI: 10.3390/molecules25092212
152. Suriyaprom S, Kaewkod T, Promputtha I, Desvaux M, Tragoolpua Y. Evaluation of Antioxidant and Antibacterial Activities of White Mulberry (*Morus alba* L.) Fruit Extracts. *Plants*., **2021;** *10:* 2736. DOI: 10.3390/plants10122736
153. Yu JS, Lim SH, Lee SR, Choi CI, Kim KH. Antioxidant and Anti-Inflammatory Effects of White Mulberry (*Morus alba* L.) Fruits on Lipopolysaccharide-Stimulated RAW 264.7 Macrophages. *Molecules,* **2021;** *26:* 920. DOI: 10.3390/molecules26040920
154. Ghosh A, Rabbani SI, Asdaq SMB, Mohzari Y, Alrashed A, Najib Alajami H, Othman Aljohani A, Ali Al Mushtawi A, Sultan Alenazy M, Fahad Alamer R, Khalid Alanazi A. *Morus alba* Prevented the Cyclophosphamide Induced Somatic and Germinal Cell Damage in Male Rats by Ameliorating the Antioxidant Enzyme Levels. *Molecules,*

2021; *26:* 1266. DOI: 10.3390/molecules26051266

155. Li Z, Chen X, Liu G, Li J, Zhang J, Cao Y, Miao J. Antioxidant Activity and Mechanism of Resveratrol and Polydatin Isolated from Mulberry (*Morus alba* L.). *Molecules,* **2021;** *26:* 7574. DOI: 10.3390/molecules26247574
156. Hsu JH, Yang CS, Chen JJ. Antioxidant, Anti-α-Glucosidase, Antityrosinase, and Anti-Inflammatory Activities of Bioactive Components from *Morus alba*. *Antioxidants,* **2022;** *11:* 2222. DOI: 10.3390/antiox11112222
157. Shi Y, Zhong L, Fan Y, Zhang J, Zhong H, Liu X, Shao C, Hu Y. The Protective Effect of Mulberry Leaf Flavonoids on High-Carbohydrate-Induced Liver Oxidative Stress, Inflammatory Response and Intestinal Microbiota Disturbance in *Monopterus albus*. *Antioxidants,* **2022;** *11:* 976. DOI: 10.3390/antiox11050976
158. Abdel-Khalek HH, Mattar ZA. Biological activities of Egyptian grape and mulberry by-products and their potential use as natural sources of food additives and nutraceuticals foods. *J Food Measur Charact*., **2022;** *16:* 1559–1571. DOI: 10.1007/s11694-022-01289-2
159. Yang TY, Wu YL, Yu MH, Hung TW, Chan KC, Wang CJ. Mulberry Leaf and Neochlorogenic Acid Alleviates Glucolipotoxicity-Induced Oxidative Stress and Inhibits Proliferation/Migration via Downregulating Ras and FAK Signaling Pathway in Vascular Smooth Muscle Cell. *Nutrients,* **2022;** *14:* 3006. DOI: 10.3390/nu14153006
160. Wu TY, Liang J, Ai JY, Cui JL, Huang WD, You YL, Zhan JC. Mulberry Ethanol Extract and Rutin Protect Alcohol-Damaged GES-1 Cells by Inhibiting the MAPK Pathway. *Molecules,* **2022;** *27:* 4266. DOI: 10.3390/molecules27134266
161. Chen T, Shuang FF, Fu QY, Ju YX, Zong CM, Zhao WG, Zhang DY, Yao XH, Cao FL. Evaluation of the Chemical Composition and Antioxidant Activity of Mulberry (*Morus alba* L.) Fruits from Different Varieties in China. *Molecules,* **2022;** *27:* 2688. DOI: 10.3390/molecules27092688
162. Zheng Q, Tan W, Feng X, Feng K, Zhong W, Liao C, Liu Y, Li S, Hu W. Protective Effect of Flavonoids from Mulberry Leaf on AAPH-Induced Oxidative Damage in Sheep Erythrocytes. *Molecules*., **2022;** *27:* 7625. DOI: 10.3390/molecules27217625
163. Gao H, Guo M, Wang L, Sun C, Huang L. Identification and Antioxidant Capacity of Free and Bound Phenolics in Six Varieties of Mulberry Seeds Using UPLC-ESI-QTOF-MS/MS. *Antioxidants,* **2022;** *11:* 1764. DOI: 10.3390/antiox11091764
164. Kim HB, Ryu S, Baek JS. The Effect of Hot-Melt Extrusion of Mulberry Leaf on the Number of Active Compounds and Antioxidant Activity. *Plants,* **2022;** *11:* 3019. DOI:

10.3390/plants11223019

165. Panyatip P, Padumanonda T, Yongram C, Kasikorn T, Sungthong B, Puthongking P. Impact of Tea Processing on Tryptophan, Melatonin, Phenolic and Flavonoid Contents in Mulberry (*Morus alba* L.) Leaves: Quantitative Analysis by LC-MS/MS. *Molecules,* **2022;** *27:* 4979. DOI: 10.3390/molecules27154979
166. Yu Y, Chen Y, Shi X, Ye C, Wang J, Huang J, Zhang B, Deng Z. Hepatoprotective effects of different mulberry leaf extracts against acute liver injury in rats by alleviating oxidative stress and inflammatory response. *Food Funct,* **2022;** *13:* 8593-8604. DOI: 10.1039/d2fo00282e
167. Ma J, Ma H, Liu S, Wang J, Wang H, Zang J, Long S, Piao X. Effect of Mulberry Leaf Powder of Varying Levels on Growth Performance, Immuno-Antioxidant Status, Meat Quality and Intestinal Health in Finishing Pigs. *Antioxidants,* **2022;** *11:* 2243. DOI: 10.3390/antiox11112243
168. Castro Pereira JP, Oliveira EA, Castro Pereira FA, Seixas JN, Oliviera Guimaraes CS, Del Bianco Borges B. Beneficial Effects of Flaxseed and/or Mulberry Extracts Supplementation in Ovariectomized Wistar Rats. *Nutrients,* **2022;** *14:* 3238. DOI: 10.3390/nu14153238
169. Jan B, Zahiruddin S, Basist P, Irfan M, Abass S, Ahmad S. Metabolomic Profiling and Identification of Antioxidant and Antidiabetic Compounds from Leaves of Different Varieties of *Morus alba* Linn Grown in Kashmir. *ACS Omega,* **2022;** *7:* 24317-24328. DOI: 10.1021/acsomega.2c01623
170. Suriyaprom S, Srisai P, Intachaisri V, Kaewkod T, Pekkoh J, Desvaux M, Tragoolpua Y. Antioxidant and Anti-Inflammatory Activity on LPS-Stimulated RAW 264.7 Macrophage Cells of White Mulberry (*Morus alba* L.) Leaf Extracts. *Molecules,* **2023;** *28:* 4395. DOI: 10.3390/molecules28114395
171. Hu L, Chen D, Zhou W, Chen X, Zhang Q. Effects of Growth Period and Storage Methods on Primary Metabolite Contents and Antioxidant Activities of *Morus alba* L. Leaf. *Molecules,* **2023;** *28:* 148. DOI: 10.3390/molecules28010148
172. Ma J, Wang J, Jin X, Liu S, Tang S, Zhang Z, Long S, Piao X. Effect of Dietary Supplemented with Mulberry Leaf Powder on Growth Performance, Serum Metabolites, Antioxidant Property and Intestinal Health of Weaned Piglets. *Antioxidants,* **2023;** *12:* 307. DOI: 10.3390/antiox12020307
173. Altaf L, Wani SA, Hussain PR, Suradkar P, Baqual MF, Bhat AA. Bioactive compounds and antioxidant activity in various parts of *Morus alba* L. Cv. ichinose: a

comparative analysis. *Discov Life*., **2024;** *54:* 7. DOI: 10.1007/s11084-024-09650-9

174. Janiak MA, Gryn-Rynko A, Sulewska K, Amarowicz R, Penkacik K, Graczyk R, Olszewska-Słonina D, Majewski MS. Correction: Phenolic profiles and antioxidant activity of *Morus alba* L. infusions prepared from commercially available products and naturally collected leaves. *Sci Rep*., **2025;** *15:* 20048. DOI: 10.1038/s41598-025-05857-6
175. Dalla Costa V, Piovan A, Brun P, Filippini R. *Morus alba* L. Cell Cultures as Sources of Antioxidant and Anti-Inflammatory Stilbenoids for Food Supplement Development. *Molecules*, **2025;** *30:* 2073. DOI: 10.3390/molecules30092073
176. Putaggio S, Russo A, Patanè GT, Calderaro A, Cirmi S, Verboso I, Laganà G, Ficarra S, Barreca D, Raymo F, Tellone E. Influence of *Morus alba* Leaves Extract on Human Erythrocytes. *Biology*, **2025;** *14:* 1005. DOI: 10.3390/biology14081005
177. Wandee J, Srinontong P, Aengwanich W, Srisanyong W. Protective effects of *Morus alba* L. leaf polyphenols against paraquat-induced apoptosis in macrophages. J Pharm Pharmacog Res., **2025;** *13:* 1409-1418. DOI: 10.56499/jppres24.2165_13.5.1409
178. Dalla Costa V, Piovan A, Brun P, Filippini R. *Morus alba* calli: A sustainable source of phytochemicals and nutritive supplements. *Nutraceuticals*, **2026;** *6:* 10. DOI: 10.3390/nutraceuticals6010010
179. Liang L, Wu X, Zhu M, Zhao W, Li F, Zou Y, Yang L. Chemical composition, nutritional value, and antioxidant activities of eight mulberry cultivars from China. *Pharmacog Mag*., **2012;** *8:* 215-224. DOI: 10.4103/0973-1296.99287
180. Zhishen J, Mengcheng T, Jianming W. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chem*., **1999;** *64:* 555-559. DOI: 10.1016/S0308-8146(98)00102-2
181. Jin Q, Yang J, Ma L, Cai J, Li J. Comparison of Polyphenol Profile and Inhibitory Activities Against Oxidation and α-Glucosidase in Mulberry (Genus *Morus*) Cultivars from China. *J Food Sci*., **2015;** *80:* C2440-C2451. DOI: 10.1111/1750-3841.13099
182. Jin Q, Yang J, Ma L, Wen D, Chen F, Li J. Identification of polyphenols in mulberry (genus *Morus*) cultivars by liquid chromatography with time-of-flight mass spectrometer. *J Food Compos Anal*., **2017;** *63:* 55-64. DOI: 10.1016/j.jfca.2017.07.005
183. Anwar F, Kanwal S, Shabir G, Alkharfy KM, Gilani AH. Antioxidant and antimicrobial attributes of different solvent extracts from leaves of four species of mulberry. *Int J Pharmacol*, **2015;** *11:* 757-765. DOI: 10.3923/ijp.2015.757.765
184. Memon AA, Memon N, Luthria DL, Bhanger MI, Pitafi AA. Phenolic acids profiling

and antioxidant potential of mulberry (*Morus laevigata* W., *Morus nigra* L., *Morus alba* L.) leaves and fruits grown in Pakistan. Pol J Food Nutr Sci., **2010;** *60:* 25-32. [ResearchGate]

185. Imran M, Khan H, Shah M, Khan R, Khan F. Chemical composition and antioxidant activity of certain *Morus* species. *J Zhejiang Univ Sci B.*, **2010;** *11:* 973-980. DOI: 10.1631/jzus.B1000173
186. Gozlekci S, Uzun HI, Yegin A. Some physico-chemical characteristics of mulberry (*Morus alba*, *Morus laevigata*, Morus nigra) species grown in western Turkey.*Acta Hortic.*, **2015;** *1106:* 191-198. DOI: 10.17660/ActaHortic.2015.1106.30
187. Krishna H, Singh D, Singh RS, Kumar L, Sharma BD, Saroj PL. Morphological and antioxidant characteristics of mulberry (*Morus* spp.) genotypes. *J Saudi Soc Agric Sci*., **2020;** *19:* 136-145. DOI: 10.1016/j.jssas.2018.08.002
188. Janakirama A, Shivayogi S, Satyanarayana J, Kumaran R. Characterization of isolated compounds from *Morus* spp. and their biological activity as anticancer molecules. *Bioimpacts,* **2021;** *11:* 187-197. DOI: 10.34172/bi.2021.09
189. Kim I, Lee J. Variations in Anthocyanin Profiles and Antioxidant Activity of 12 Genotypes of Mulberry (*Morus* spp.) Fruits and Their Changes during Processing. *Antioxidants,* **2020;** *9:* 242. DOI: 10.3390/antiox9030242
190. Sývacý A, Sökmen M. Seasonal changes in antioxidant activity, total phenolic and anthocyanin constituent of the stems of two *Morus* species (*Morus alba* L. and *Morus nigra* L.). *Plant Growth Regul*., **2004;** *44:* 251-256. DOI: 10.1007/s10725-004-4500-4
191. Sivaci A, Sökmen M. Seasonal changes in antioxidant activity, total phenolic and anthocyanin constituent of the stems of two *Morus* species (*Morus alba* L. and *Morus nigra* L.). *Plant Growth Regul*., **2008;** *54:* 251. DOI: 10.1007/s10725-008-9257-8 (This is a correction of previous publication)
192. Ercisli S, Tosun M, Duralija B, Voća S, Sengul M, Turan M. Phytochemical Content of Some Black (*Morus nigra* L.) and Purple (*Morus rubra* L.) Mulberry Genotypes. *Food Technol Biotechnol*., **2010;** *48:* 102-106. [ResearchGate]
193. Radojković M, Zeković Z, Vidovic S, Kočar D, Mašković P. Free radical scavenging activity and total phenolic and flavonoid contents of mulberry (*Morus* spp. L., Moraceae) extracts. *Hem Ind.,* **2012;** *66:* **5**47-552. DOI: 10.2298/HEMIND111111002R
194. Rebai O, Belkhir M, Amri M, Fattouch S. Antioxidant activity and phenolic extracts of black (*Morus nigra* L.) and White (*Morus alba* L.) mulberry fruits. *Biol Tunisie,* **2012;** *7:* 26-29. [Journal website]

195. Arfan M, Khan R, Rybarczyk A, Amarowicz R. Antioxidant Activity of Mulberry Fruit Extracts. *Int J Mol Sci.*, **2012;** *13:* 2472-2480. DOI:10.3390/ijms13022472
196. Mahmoud MY. Natural antioxidants effect of mulberry fruits (*Morus nigra* and *Morus alba* L.) on lipids profile and oxidative stress in hypercholestrolemic rats. *Pak J Nutr*., **2013;** *12:* 665-672. DOI: 10.3923/pjn.2013.665.672
197. Popescu GS, Velciov AB, Costescu C, Gogoasa I, Gravila C, Petolescu C. Chemical characterisation of white (*Morus alba*), and black (*Morus nigra*) mulberry fruits. *J Hortic For Biotechnol*, **2014;** *18:* 133-135. [Google scholar]
198. Mahmoud HI, ElRab SM, Khalil AF, Ismael SM. Hypoglycemic effect of white (*Morus alba* L.) and black (*Morus nigra* L.) mulberry fruits in diabetic rat. *Eur J Chem*., **2014;** *5:* 65-72. DOI: 10.5155/eurjchem.5.1.65-72.903
199. Mnaa S, Aniess W, Olwy Y, Shaker E. Antioxidant Activity of White (*Morus alba* L.) and Black (*Morus nigra* L.) Berries against CCl4 Hepatotoxic Agent. *Adv Tech Biol Med*., **2015;** *3:* 121. DOI: 10.4172/2379-1764.1000121
200. Eyduran SP, Ercisli S, Akin M, Beyhan O, Geçer MK, Eyduran E, Erturk YE. Organic acids, sugars, vitamin C, antioxidant capacity, and phenolic compounds in fruits of white (*Morus alba* L.) and black (*Morus nigra* L.) mulberry genotypes. *J Appl Bot Food Qual*., **2015;** *88:* 134-138. DOI: 10.5073/JABFQ.2015.088.019
201. Sánchez-Salcedo EM, Mena P, García-Viguera C, Martínez JJ, Hernández F. Phytochemical evaluation of white (*Morus alba* L.) and black (*Morus nigra* L.) mulberry fruits, a starting point for the assessment of their beneficial properties. *J Funct Foods*., **2015;** *12:* 399-408. DOI: 10.1016/j.jff.2014.12.010
202. Sánchez-Salcedo EM, Mena P, García-Viguera C, Hernández F, Martínez JJ. (Poly) phenolic compounds and antioxidant activity of white (*Morus alba*) and black (*Morus nigra*) mulberry leaves: Their potential for new products rich in phytochemicals. *J Funct Foods*., **2015;** *18:* 1039-1046. DOI: 10.1016/j.jff.2015.03.053
203. Gecer MK, Akin M, Gundogdu M, Eyduran SP, Ercisli S, Eyduran E. Organic acids, sugars, phenolic compounds, and some horticultural characteristics of black and white mulberry accessions from Eastern Anatolia. *Can J Plant Sci*., **2016;** *96:* 27-33. DOI: 10.1139/cjps-2015-0070
204. Akin M, Eyduran SP, Ercisli S, Kapchina-Toteva V, Eyduran E. Phytochemical profiles of wild blackberries, black and white mulberries from southern Bulgaria. *Biotechnol Biotechnol Equip*, **2016;** *30:* 899-906, DOI: 10.1080/13102818.2016.1204943
205. Tripathi P, Iqbal S, Singh A. Total antioxidant potential of indigenous Indian plants. *J*

Chem Pharm Res., **2016;** *8:* 579-583. [ResearchGate]

206. Gundogdu M, Canan I, Gecer MK, Kan T, Ercisli S. Phenolic compounds, bioactive content and antioxidant capacity of the fruits of mulberry (Morus spp.) germplasm in Turkey. *Folia Hort*., **2017;** *29:* 251-262. DOI: 10.1515/fhort-2017-0023
207. Balik A, Gecer MK, Aslantaş R. Diversity of biochemical content in fruits of some indigenous mulberry genotypes. *Turk J Agric Fores*., **2019;** *43:* 28-35. DOI: 10.3906/tar-1806-69.
208. Nani Pohrib E, Corciova A, Cioanca O, Hritcu L, Hancianu M, Mitran AM, Burlec AF, Cimpanu AM, Isac CM, Huzum R, Danu E, Mircea C. Antioxidant, Anti-Cholinesterase, and Neuroprotective Properties of *Morus alba* and *Morus nigra* Extracts. *Antioxidants*, **2026;** *15:* 510. DOI: 10.3390/antiox15040510
209. Thabti I, Marzougui N, Elfalleh W, Ferchichi A. Antioxidant composition and antioxidant activity of white (*Morus alba* L.), black (*Morus nigra* L.) and red *(Morus rubra* L.) mulberry leaves, *Acta Bot Gall*., **2011;** *158:* 205-214, DOI: 10.1080/12538078.2011.10516267
210. Gundogdu M, Muradoglu F, Sensoy RG, Yilmaz HJ. Determination of fruit chemical properties of *Morus nigra* L., *Morus alba* L. and *Morus rubra* L. by HPLC. Sci Hort, **2011;** *132:* 37-41. DOI: 10.1016/j.scienta.2011.09.035
211. Iqbal S, Younas U, Sirajuddin, Chan KW, Sarfraz RA, Uddin MK. Proximate composition and antioxidant potential of leaves from three varieties of Mulberry (*Morus* sp.): a comparative study. *Int J Mol Sci*., **2012;** *13:* 6651-6664. DOI: 10.3390/ijms13066651
212. Thabti I, Elfalleh W, Tlili N, Ziadi M, Campos MG, Ferchichi A. Phenols, Flavonoids, and Antioxidant and Antibacterial Activity of Leaves and Stem Bark of *Morus* Species. *Int J Food Prop*., **2014;** *17:* 842-854. DOI: 10.1080/10942912.2012.660722
213. Dimitrova MP, Petkova NT, Denev PP, Aleksieva IN. Carbohydrate composition and antioxidant activity of certain *Morus* species. *Int J Pharmacog Phytochem Res*., **2015;** *7:* 621-627. [ResearchGate]
214. Aljane F, Sdiri N. Morphological, phytochemical and antioxidant characteristics of white (*Morus alba* L.), red (*Morus rubra* L.) and black (*Morus nigra* L.) mulberry fruits grown in arid regions of Tunisia. *J New Sci*., **2016;** *35:* 1940-1947. [ResearchGate]
215. Ionica ME, Nour V, Trandafir I. Bioactive compounds and antioxidant capacity of some *Morus* species. *South-Western J Hortic Biol Env*., **2017;** *8:* 79-88. [ResearchGate]
216. El-Baz FK, Hassan AZ, Abd-Alla HI, Aly HF, Mahmoud K. Phytochemical analysis,

assessment of antiproliferative and free radical scavenging activity of Morus alba and Morus rubra fruits. Asian J Pharm Clin Res., **2017;** *10:* 189-199. DOI: 10.22159/ajpcr.2017.v10i6.18029

217. Gündoğdu M, Tunçtürk M, Berk S, Şekeroğlu N, Gezici S. Antioxidant capacity and bioactive contents of mulberry species from Eastern Anatolia region of Turkey. *Indian J Pharm Edu Res*., **2018;** *52:* 96-101. DOI: 10.5530/ijper.52.4s.82
218. El-Baz FK, Aly HF, Abd-Alla HI, Ali SA. Neurorestorative mulberries potential of Alzheimer's disease in animal model. Asian *J Pharm Clin Res*., **2018;** *11:* 318-324. DOI: 10.22159/ajpcr.2018.v11i10.27155
219. Isabelle M, Lee BL, Ong CN, Liu X, Huang D. Peroxyl radical scavenging capacity, polyphenolics, and lipophilic antioxidant profiles of mulberry fruits cultivated in southern China. *J Agric Food Chem*., **2008;** *56:* 9410-9416. DOI: 10.1021/jf801527a
220. Shih PH, Chan YC, Liao JW, Wang MF, Yen GC. Antioxidant and cognitive promotion effects of anthocyanin-rich mulberry (*Morus atropurpurea* L.) on senescence-accelerated mice and prevention of Alzheimer's disease. *J Nutr Biochem*., **2010;** *21:* 598-605. DOI: 10.1016/j.jnutbio.2009.03.008
221. Wu X, Liang L, Zou Y, Zhao T, Zhao J, Li F, Yang L. Aqueous two-phase extraction, identification and antioxidant activity of anthocyanins from mulberry (*Morus atropurpurea* Roxb.). *Food Chem*., **2011;** *129:* 443-453. DOI: 10.1016/j.foodchem.2011.04.097
222. Liang L, Wu X, Zhao T, Zhao J, Li F, Zou Y, Mao G, Yang L. In vitro bioaccessibility and antioxidant activity of anthocyanins from mulberry (*Morus atropurpurea* Roxb.) following simulated gastro-intestinal digestion. Food Res Int., **2012;** *46:* 76-82. DOI: 10.1016/j.foodres.2011.11.024
223. Liu F, Hou RH, Liao ST, Zou YX, Xiao GS. Optimisation of Ultrasonic-Microwave-Assisted Extraction Conditions for Polysaccharides from Mulberry (*Morus atropurpurea Roxb*) Leaves and Evaluation of Antioxidant Activities *in vitro*. *Med chem*., **2015;** *5:* 090-095. DOI: 10.4172/2161-0444.1000248
224. Yang J, Liu X, Zhang X, Jin Q, Li J. Phenolic Profiles, Antioxidant Activities, and Neuroprotective Properties of Mulberry (*Morus atropurpurea* Roxb.) Fruit Extracts from Different Ripening Stages. *J Food Sci*., **2016;** *81:* C2439-C2446. DOI: 10.1111/1750-3841.13426
225. Sun C, Wu W, Ma Y, Min T, Lai F, Wu, H. Physicochemical, functional properties, and antioxidant activities of protein fractions obtained from mulberry (*Morus*

atropurpurea roxb.) leaf. *Int J Food Prop*., **2017;** *20:* S3311-S3325. DOI: 10.1080/10942912.2016.1238389

226. Yang J, Ou X, Zhang X, Zhou Z, Ma L. Effect of Different Solvents on the Measurement of Phenolics and the Antioxidant Activity of Mulberry (*Morus atropurpurea* Roxb.) with Accelerated Solvent Extraction. *J Food Sci*., **2017;** *82:* 605-612. DOI: 10.1111/1750-3841.13638
227. Li Q, Dai Y, Zou Y, Liao S, Shen W, Hu T, Liu F. Mulberry (*Morus atropurpurea* Roxb.) leaf polyphenols inhibits adipogenesis and lipogenesis-related gene expression in 3T3-L1 adipocytes. *J Food Biochem*, **2018;** *42:* e12599. DOI: 10.1111/jfbc.12599
228. Wang Z, Lin Y, Li T, Dai F, Luo G, Xiao G, Tang C. Phenolic profiles and antioxidant capacities of mulberry (*Morus atropurpurea* Roxb.) juices from different cultivars. *Int J Food Prop*., **2019;** *22:* 1340-1352. DOI: 10.1080/10942912.2019.1646272
229. Sun C, Tang X, Ren Y, Wang E, Shi L, Wu X, Wu H. Novel antioxidant peptides purified from mulberry (*Morus atropurpurea* Roxb.) leaf protein hydrolysates with hemolysis inhibition ability and cellular antioxidant activity. *J Agric Food Chem*., **2019;** *67:* 7650-7659. DOI: 10.1021/acs.jafc.9b01115
230. Horng CT, Liu ZH, Huang YT, Lee HJ, Wang CJ. Extract from Mulberry (Morus australis) leaf decelerate acetaminophen induced hepatic inflammation involving downregulation of myeloid differentiation factor 88 (MyD88) signals. *J Food Drug Anal*., **2017;** *25:* 862-871. DOI: 10.1016/j.jfda.2016.07.011
231. Tseng TH, Lin WL, Chang CK, Lee KC, Tung SY, Kuo HC. Protective Effects of Morus Root Extract (MRE) Against Lipopolysaccharide-Activated RAW264.7 Cells and CCl_4-Induced Mouse Hepatic Damage. *Cell Physiol Biochem*., **2018;** *51:* 1376-1388. DOI: 10.1159/000495555
232. Jin YS, Sa JH, Shim TH, Rhee HI, Wang MH. Hepatoprotective and antioxidant effects of *Morus bombycis* Koidzumi on CCl_4-induced liver damage. *Biochem Biophys Res Commun*, **2005;** *329:* 991-995. DOI: 10.1016/j.bbrc.2005.02.076
233. Jin YS, Lee MJ, Han W, Heo SI, Sohn SI, Wang MH. Antioxidant effects and hepatoprotective activity of 2,5-dihydroxy-4,3'-di(beta-d-glucopyranosyloxy)-*trans*-stilbene from *Morus bombycis* Koidzumi roots on CCl_4-induced liver damage. *Free Radic Res*., **2006;** *40:* 986-992. DOI: 10.1080/10715760600803823
234. Heo SI, Jin YS, Jung MJ, Wang MH. Antidiabetic properties of 2,5-dihydroxy-4,3'-di(beta-D-glucopyranosyloxy)-trans-stilbene from mulberry (*Morus bombycis* koidzumi) root in streptozotocin-induced diabetic rats. *J Med Food.*, **2007;** *10:* 602-607.

DOI: 10.1089/jmf.2006.0241

235. Heo JI, Kim JH, Lee JM, Kho YJ, Lim SS, Park JB, Kim J, Kim SC, Lee JY. FOXO3a Activation by oxyresveratrol of *Morus bombycis* koidzumi extract mediates antioxidant activity. *Anim Cells Syst*, **2016;** *20:* 39-47. DOI: 10.1080/19768354.2016.1143030
236. Zhang QJ, Ni G, Wang YH, Chen RY, Yu DQ. Three new Diels–Alder type adducts from the stem bark of *Morus cathayana*. *J Asian Nat Prod Res*., **2009;** *11:* 267-273. DOI: 10.1080/10286020902767690
237. Viveros-Valdez E, Oranday-Cárdenas A, Rivas-Morales C, Verde-Star MJ, Carranza-Rosales P. Biological activities of *Morus celtidifolia* leaf extracts. *Pak J Pharm Sci*., **2015;** *28:* 1177-1180. [ResearchGate]
238. Andallu B, Varadacharyulu NC. Antioxidant role of mulberry (*Morus indica* L. cv. Anantha) leaves in streptozotocin-diabetic rats. *Clin Chim Acta*., **2003;** *338:* 3-10. DOI: 10.1016/s0009-8981(03)00322-x
239. Prasad L, Khan TH, Sehrawat A, Sultana S. Modulatory effect of *Morus indica* against two-stage skin carcinogenesis in Swiss albino mice: possible mechanism by inhibiting aryl hydrocarbon hydroxylase. *J Pharm Pharmacol*, **2004;** *56:* 1291-1298. DOI: 10.1211/0022357044373
240. Arabshahi-Delouee S, Urooj A. Antioxidant properties of various solvent extracts of mulberry (*Morus indica* L.) leaves. *Food Chem*., **2007;** *102:* 1233-1240. DOI: 10.1016/j.foodchem.2006.07.013
241. Roy LG, Arabshahi-Delouee S, Urooj A. Antioxidant Efficacy of Mulberry (*Morus indica* L.) Leaves Extract and Powder in Edible Oil. *Int J Food Prop*., **2010;** *13:* 1-9. DOI: 10.1080/10942910802120139
242. Kumar RP, Sujatha D, Saleem TsM, Chetty CM, Ranganayakulu D. Potential antidiabetic and antioxidant activities of *Morus indica* and *Asystasia gangetica* in alloxan-induced diabetes mellitus. *J Exp Pharmacol*, **2010;** *2:* 29-36. DOI: 10.2147/jep.s8947
243. Reddy PV, Urooj A. *Morus indica*: antioxidant activity in food and biological systems. *Int J Pharm Biol Sci*., **2013;** 4: 706-715. [ResearchGate]
244. Reddy VP, Urooj A. Proximate, phytochemical profile and antioxidant activity (in vitro and ex vivo) of *Morus indica* varieties. *Int J Pharm Sci Res*., **2013;** *4:* 1626-1634. [ResearchGate]
245. Bondada A, Allagadda Venkata VK, Nallanchakravarthula V. Influence of mulberry (*Morus indica* L.) leaves on antioxidants and antioxidant enzymes in STZ-diabetic

rats. *Int J Diabetes Dev Ctries*., **2014;** *34:* 69-76. DOI: 10.1007/s13410-013-0139-x

246. Priya MC, Manasa M, Jakriya S, Kavya C, Sai GU, Somanathan SS, Ranganayakulu D. Effects of *Morus indica* leaf extract on repeatedly used oil (rancid) food induced tissue damage in experimental rats. *World J Pharm Res*., **2016;** *5:* 1363-1373. DOI: 10.20959/wjpr20166-6320
247. Reddy VP, Urooj A. Evaluation of hepatoprotective activity of *Morus indica* Linn. against toxicity induced by carbon tetrachloride in rats. *Int J Pharm Sci Res*., **2017;** *8:* 845-851. DOI: 10.13040/IJPSR.0975-8232.8(2).845-51
248. Ma Y, Lv W, Gu Y, Yu S. 1-Deoxynojirimycin in Mulberry (*Morus indica* L.) Leaves Ameliorates Stable Angina Pectoris in Patients With Coronary Heart Disease by Improving Antioxidant and Anti-inflammatory Capacities. *Front Pharmacol,* **2019;** *10:* 569. DOI: 10.3389/fphar.2019.00569
249. Pai Kotebagilu N, Mysuru Shivanna L, Urooj A. Anti-Cancer Potential of *Morus indica* Hybrid Varieties in HT-29 Cancer Cell Lines: An Exploratory Study. *Int J Pharm Sci Res*., **2021;** *12:* 587-596. DOI: 10.13040/IJPSR.0975-8232.12(1).587-96
250. Boro H, Usha T, Babu D, Chandana P, Goyal AK, Ekambaram H, Yusufoglu HS, Das S, Middha SK. Hepatoprotective activity of the ethanolic extract of *Morus indica* roots from Indian Bodo tribes. *SN Appl Sci*., **2022;** *4:* 49. DOI: 10.1007/s42452-021-04859-z
251. Joty FA, Hasan MM, Khatun R, Billah MM, Miah MM, Mahmud S, Reza MA, Ferdousi Z. Evaluation of antibacterial and antioxidant activity of three plant species from *Morus* genus. *Int J Biosci,* **2019;** *14:* 183-189. DOI: 10.12692/ijb/14.2.183-189
252. Islam MS, Jahangir CA, Rahi MS, Hasan MM, Sajib SA, Hoque KM, Reza MA. In-vivo antiproliferative activity of *Morus latifolia* leaf and bark extracts against Ehrlich's ascites carcinoma. *Toxicol Res*., **2020;** *36:* 79-88. DOI: 10.1007/s43188-019-00011-7
253. Mahmood T, Anwar F, Abbas M, Saari N. Effect of maturity on phenolics (phenolic acids and flavonoids) profile of strawberry cultivars and mulberry species from Pakistan. *Int J Mol Sci*., **2012;** *13:* 4591-4607. DOI: 10.3390/ijms13044591
254. Dai SJ, Ma ZB, Wu Y, Chen RY, Yu DQ. Guangsangons F-J, anti-oxidant and anti-inflammatory Diels-Alder type adducts, from *Morus macroura* Miq. *Phytochemistry,* **2004;** *65:* 3135-3141. DOI: 10.1016/j.phytochem.2004.07.010
255. Dai SJ, Wu Y, Wang YH, He WY, Chen RY, Yu DQ. New Diels-Alder type adducts from *Morus macroura* and their anti-oxidant activities. Chem Pharm Bull., **2004;** *52:* 1190-1193. DOI: 10.1248/cpb.52.1190
256. Dai SJ, Yu DQ. A new anti-oxidant Diels-Alder type adduct from *Morus macroura*. *Nat*

Prod Res., **2006;** *20:* 676-679. DOI: 10.1080/14786410500462868

257. Khalil RA, Embaby HE. Using long red mulberry (*Morus macroura*) pulp as a source of natural antioxidants in making functional yoghurt drink. *Egypt J Dairy Sci*., **2017;** *45:* 45-53. [ResearchGate]
258. Farrag EK, Kassem ME, Bayoumi D, Shaker SE, Afifi MS. Phytochemical study, phenolic profile and antigastric ulcer activity of *Morus macroura* Miq. fruits extract. *J Appl Pharm Sci*., **2017;** *7:* 152-160. DOI: 10.7324/JAPS.2017.70527
259. Hamdan DI, Salah S, Hassan WHB, Morsi M, Khalil HMA, Ahmed-Farid OA, El-Shiekh RA, Nael MA, Elissawy AM. Anticancer and Neuroprotective Activities of Ethyl Acetate Fractions from *Morus macroura* Miq. Plant Organs with Ultraperformance Liquid Chromatography-Electrospray Ionization-Tandem Mass Spectrometry Profiling. *ACS Omega*, **2022;** *7:* 16013-16027. DOI: 10.1021/acsomega.2c01148
260. Kapche GD, Fozing CD, Donfack JH, Fotso GW, Amadou D, Tchana AN, Bezabih M, Moundipa PF, Ngadjui BT, Abegaz BM. Prenylated arylbenzofuran derivatives from *Morus mesozygia* with antioxidant activity. *Phytochemistry*, **2009;** *70:* 216-221. DOI: 10.1016/j.phytochem.2008.12.014
261. Kapche GD, Amadou D, Waffo-Teguo P, Donfack JH, Fozing CD, Harakat D, Tchana AN, Mérillon JM, Moundipa PF, Ngadjui BT, Abegaz BM. Hepatoprotective and antioxidant arylbenzofurans and flavonoids from the twigs of *Morus mesozygia*. *Planta Med.*, **2011;** *77:* 1044-1047. DOI: 10.1055/s-0030-1270745
262. Elisha IL, Dzoyem JP, McGaw LJ, Botha FS, Eloff JN. The anti-arthritic, anti-inflammatory, antioxidant activity and relationships with total phenolics and total flavonoids of nine South African plants used traditionally to treat arthritis. *BMC Complement Altern Med*., **2016;** *16:* 307. DOI: 10.1186/s12906-016-1301-z
263. Oshiomah KO, Odujoko OA, Ajayi AM. Anti-Inflammatory Effects and Acute Toxicity of Methanol Stem Bark Extract of *Morus mesozygia* Stapf. *J Pharm Res Int*., **2016;** *13:* 1-9. DOI: 10.9734/BJPR/2016/28746
264. Kang J, Chen RY, Yu DQ. Diels-alder type adducts in stem bark of *Morus mongolica*. *Chin Trad Herb Drugs*, **2006;** *37:* 976-979. [ResearchGate]
265. Kang J, Chen RY, Yu DQ. Five new Diels-Alder type adducts from the stem and root bark of *Morus mongolica*. *Planta Med*., **2006;** *72:* 52-59. DOI: 10.1055/s-2005-873190
266. Choi SW, Shin YW, Lee SK, Kwon YJ, Rhee SJ. Radical Scavenging Activities of Phenolic Compounds Isolated from Mulberry (*Morus* spp.) Cake. *Prev Nutr Food Sci*.,

2005; 10: 326-332. [Journal website]

267. Guo Z, Lai J, Wu Y, Fang S, Liang X. Investigation on Antioxidant Activity and Different Metabolites of Mulberry (*Morus* spp.) Leaves Depending on the Harvest Months by UPLC-Q-TOF-MS with Multivariate Tools. *Molecules,* **2023;** *28:* 1947. DOI: 10.3390/molecules28041947
268. Liu HY, Wang J, Ma J, Zhang YQ. Interference effect of oral administration of mulberry branch bark powder on the incidence of type II diabetes in mice induced by streptozotocin. *Food Nutr Res*., **2016;** *60:* 31606. DOI: 10.3402/fnr.v60.31606
269. Wang F, Du BL, Cui ZW, Xu LP, Li CY. Effects of high hydrostatic pressure and thermal processing on bioactive compounds, antioxidant activity, and volatile profile of mulberry juice. *Food Sci Technol Int*., **2017;** *23:* 119-127. DOI: 10.1177/1082013216659610
270. Qiu F, Wang J, Liu HY, Zhang YQ. Mulberry Bark Alleviates Effect of STZ Inducing Diabetic Mice through Negatively Regulating FoxO1. *Evid Based Complement Alternat Med*., **2019;** 2182865. DOI: 10.1155/2019/2182865
271. Taufik Y, Widiantara T, Garnida Y. The effect of drying temperature on the antioxidant activity of black mulberry leaf tea (*Morus nigra*). *Rasayan J Chem*., **2016;** *9:* 889-895. [ResearchGate]
272. Naderi GA, Asgary S, Sarraf Zadegan N, Boshtam M, Rafie M. Antioxidant effects of *Morus nigra* on LDL oxidation, red blood cells hemolysis, liver cells oxidation and protein glycosylation. *Atherosclerosis,* **1999;** *144:* 156. DOI: 10.1016/S0021-9150(99)80598-X
273. Naderi GA, Asgary S, Sarraf-Zadegan N, Oroojy H, Afshin-Nia F. Antioxidant activity of three extracts of *Morus nigra*. *Phytother Res*., **2004;** *18:* 365-369. DOI: 10.1002/ptr.1400
274. Hassimotto NM, Genovese MI, Lajolo FM. Identification and characterisation of anthocyanins from wild mulberry (*Morus nigra* L.) growing in Brazil. *Food Sci Technol Int*., **2007;** *13:* 17-25. DOI: 10.1177/1082013207075602
275. Yiğit D, Mavi A, Aktaş M. Antioxidant activities of black mulberry (*Morus nigra*). *Erzincan Univ J Sci Technol,* **2008;** *1:* 223-232. [Journal website]
276. Hassimotto NM, Genovese MI, Lajolo FM. Absorption and metabolism of cyanidin-3-glucoside and cyanidin-3-rutinoside extracted from wild mulberry (*Morus nigra* L.) in rats. *Nutr Res*., **2008;** *28:* 198-207. DOI: 10.1016/j.nutres.2007.12.012
277. El-Khawaga OY, Abou-Seif MA. Biochemical studies on antioxidant and oxidant

activities of some plant extracts. *Eur Rev Med Pharmacol Sci*., **2010;** *14:* 731-738. [ResearchGate]

278. Wang L, Yang Y, Liu C, Chen RY. Three new compounds from *Morus nigra* L. *J Asian Nat Prod Res*., **2010;** *12:* 431-437. DOI: 10.1080/10286020.2010.489824
279. Kutlu TÜ, Durmaz GÖ, Ateş BU, Yilmaz I, Çetin MŞ. Antioxidant properties of different extracts of black mulberry (*Morus nigra* L.). Turkish J Biol., **2011; 35:** 103-110. DOI: 10.3906/biy-0904-22
280. Araujo CM, Lúcio Kde P, Silva ME, Isoldi MC, de Souza GH, Brandão GC, Schulz R, Costa DC. *Morus nigra* leaf extract improves glycemic response and redox profile in the liver of diabetic rats. *Food Funct*., **2015;** *6:* 3490-3499. DOI: 10.1039/c5fo00474h
281. Kumar A, Chauhan PK, Bhardwaj VS, Kumar R, Tyagi A. *In vitro* antioxidant and phytochemical investigations of ethanolic extracts of *Viola serpens* and *Morus nigra*. *J Chem Pharm Res*., **2011;** 3: 166-171. [ResearchGate]
282. Aydin S, Yilmaz Ö, Gökçe Z. Effectiveness of matured *Morus nigra L.* (black mulberry) fruit extract on 2,2-diphenyl-1-picrylhydrazyl (DPPH●) and hydroxyl (OH●) radicals as compared to less matured fruit extract. *Afr J Biotechnol*, **2011;** *10:* 16037-16044, DOI: 10.5897/AJB11.261
283. Volpato GT, Calderon IM, Sinzato S, Campos KE, Rudge MV, Damasceno DC. Effect of *Morus nigra* aqueous extract treatment on the maternal-fetal outcome, oxidative stress status and lipid profile of streptozotocin-induced diabetic rats. *J Ethnopharmacol, 2011; 138:* 691-696. DOI: 10.1016/j.jep.2011.09.044
284. Pérez-Gregorio MR, Regueiro J, Alonso-González E, Pastrana-Castro LM, Simal-Gándara J. Influence of alcoholic fermentation process on antioxidant activity and phenolic levels from mulberries (*Morus nigra* L.). *LWT Food Sci Technol*., **2011;** *44:* 1793-1801. DOI: 10.1016/j.lwt.2011.03.007
285. Khalid N, Fawad SA, Ahmed I. Antimicrobial activity, phytochemical profile and trace minerals of black mulberry (*Morus nigra* L.) fresh juice. *Pak J Bot*., **2011;** *43:* 91-96. [ResearchGate]
286. Mazimba O, Majinda RR, Motlhanka D. Antioxidant and antibacterial constituents from *Morus nigra*. *Afr J Pharm Pharm*., **2011;** *5:* 751-754. DOI: 10.5897/AJPP11.260
287. Issa NK, Abd-AljabarP RS. Evaluation of Antioxidant Properties of *Morus nigra* L. Fruit Extracts [II]. *Jordan J Biol Sci*., **2013;** *6:* 258-265. [Journal website]
288. Kamiloglu S, Serali O, Unal N, Capanoglu E. Antioxidant activity and polyphenol composition of black mulberry (*Morus nigra* L.) products. *J Berry Res*., **2013;** *3:* 41-51.

DOI: 10.3233/JBR-130045

289. Kostić DA, Dimitrijević DS, Mitić SS, Mitić MN, Stojanović GS, Živanović AV. Phenolic content and antioxidant activities of fruit extracts of *Morus nigra* L (Moraceae) from Southeast Serbia.*Trop J Pharm Res*., **2013;** *12:* 105-110. DOI: 10.4314/tjpr.v12i1.17
290. Shukla RK, Painuly D, Shukla A, Singh J, Porval A, Vats S. *In vitro* biological activity and total phenolic content of *Morus nigra* seeds. *J Chem Pharm Res*., **2014;** *6:* 200-210. [ResearchGate]
291. Tarko T, Duda-Chodak A, Satora P, Sroka P, Pogoń P, Machalica J. *Chaenomeles japonica*, *Cornus mas*, *Morus nigra* fruits characteristics and their processing potential. *J Food Sci Technol*, **2014;** *51:* 3934-3941. DOI: 10.1007/s13197-013-0963-5
292. Abbas GM, Abdel Bar FM, Baraka HN, Gohar AA, Lahloub MF. A new antioxidant stilbene and other constituents from the stem bark of *Morus nigra* L. *Nat Prod Res*., **2014;** *28:* 952-959. DOI: 10.1080/14786419.2014.900770
293. Jiang B, Mantri N, Hu Y, Lu J, Jiang W, Lu H. Evaluation of bioactive compounds of black mulberry juice after thermal, microwave, ultrasonic processing, and storage at different temperatures. *Food Sci Technol Int*., **2015;** *21:* 392-399. DOI: 10.1177/1082013214539153
294. Feng RZ, Wang Q, Tong WZ, Xiong J, Wei Q, Zhou WH, Yin ZQ, Yin XY, Wang LY, Chen YQ, Lai YH, Huang HY, Luo QL, Wang L, Jia RY, Song X, Zou YF, Li LX. Extraction and antioxidant activity of flavonoids of *Morus nigra*. *Int J Clin Exp Med*., **2015;** *8:* 22328-22336. [ResearchGate]
295. Khattak KF, Rahman TR. Effect of geographical distributions on the nutrient composition, phytochemical profile and antioxidant activity of *Morus nigra*. *Pak J Pharm Sci*., **2015;** *28:* 1671-1678. [ResearchGate]
296. Xia N, Chen Y, Tao H. Protective effect of polysaccharides from *Morus nigra* Linn. fruits on CCl_4-induced liver damage in rats. *Food Sci*., **2015;** *36:* 247-251. DOI: 10.7506/spkx1002-6630-201513046 [Article in Chinese]
297. Aydin S, Yilmaz Ö, Gökçe Z. Protective effect of *Morus nigra* L. (Mulberry) fruit extract on the liver fatty acid profile of Wistar rats. *Pak J Zool*., **2015;** *47:* 255-261. [ResearchGate]
298. Turgut NH, Mert DG, Kara H, Egilmez HR, Arslanbas E, Tepe B, Gungor H, Yilmaz N, Tuncel NB. Effect of black mulberry (*Morus nigra*) extract treatment on cognitive impairment and oxidative stress status of D-galactose-induced aging mice. *Pharm Biol*.,

2016; *54:* 1052-1064. DOI: 10.3109/13880209.2015.1101476

299. Carvalho L, Cerdeira C, Santos G, Salles B, de Carvalho P, Oliveira N, dos Reis L, Brigagão M. Modulatory effects of the mulberry leaf extract on reactive oxygen species generation during the neutrophil respiratory burst. *J Sci*., **2016;** *6:* 435-431. [Journal website]
300. Turan I, Demir S, Kilinc K, Burnaz NA, Yaman SO, Akbulut K, Mentese A, Aliyazicioglu Y, Deger O. Antiproliferative and apoptotic effect of *Morus nigra* extract on human prostate cancer cells. *Saudi Pharm J*., **2016;** *25:* 241-248. DOI: 10.1016/j.jsps.2016.06.002
301. Kucelova L, Grygorieva O, Ivanišová E, Margarita T, Brindza J. Biological properties of black mulberry-derived food products (*Morus nigra* L.). *J Berry Res*., **2016;** *6:* 333-343. DOI: 10.3233/JBR-160141
302. Čestić S, Radojković M, Cvetanović A, Mašković P, Đurović S. Phytochemical profile and biological potential of mulberry teas (*Morus nigra* L.). *Acta Agric Serb*., **2016;** *21:* 25-35. DOI: 10.5937/AASer1641025C
303. Okatan V, Polat M, Aşkin MA. Some physico-chemical characteristics of black mulberry (*Morus nigra* L.) in Bitlis. *Horticulture*, **2016;** *LX:* 27-30. [ResearchGate]
304. Chen H, Pu J, Liu D, Yu W, Shao Y, Yang G, Xiang Z, He N. Anti-Inflammatory and Antinociceptive Properties of Flavonoids from the Fruits of Black Mulberry (*Morus nigra* L.). *PLoS ONE*., **2016;** *11:* e0153080. DOI: 10.1371/journal.pone.0153080
305. Mehmood T, Qadeer HI, Jabeen Z, Karim A. Variation in bioactive compounds, phenolic acids and antibacterial activities of extracts acquired from fruits of *Morus nigra* in relation to solvents system. *Biologia* (Pakistan), **2016;** *62:* 229-239. [Google scholar]
306. Minhas MA, Begum A, Hamid S, Babar M, Ilyas R, Ali S, Latif F, Andleeb S. Evaluation of Antibiotic and Antioxidant Activity of *Morus nigra* (Black Mulberry) Extracts Against Soil Borne, Food Borne and Clinical Human Pathogens. *Pak J Zool*., **2016;** *48:* 1381-1388. [ResearchGate]
307. Zeni AB, Moreira TD, Dalmagro AP, Camargo A, Bini LA, Simionatto EL, Scharf DR. Evaluation of phenolic compounds and lipid-lowering effect of *Morus nigra* leaves extract. *An Acad Bras Cienc*., **2017;** *89:* 2805-2815. DOI: 10.1590/0001-3765201720160660
308. Júnior IID, Barbosa HM, Carvalho DC, Barros RA, Albuquerque FP, da Silva DH, Souza GR, Souza NAC, Rolim LA, Silva FM, Duarte GI, Almeida JR, de Oliveira FM,

Gomes DA, Lira EC. Brazilian *Morus nigra* Attenuated Hyperglycemia, Dyslipidemia, and Prooxidant Status in Alloxan-Induced Diabetic Rats. *Sci World J*., **2017;** 5275813. DOI: 10.1155/2017/5275813

309. Deniz Yilmaz G. Protective mechanism of *Morus nigra* on carbon tetrachloride induced brain damage in rats. *Vet J MAE Univ*., **2017;** *2:* 97-108. DOI: 10.24880/maeuvfd.341661
310. Montenote MC, Wajsman VZ, Konno YT, Ferreira PC, Silva RM, Therezo AL, Silva LP, Martins LP. Antioxidant effect of *Morus nigra* on Chagas disease progression. *Rev Inst Med Trop*., **2017;** *59:* e73. DOI: 10.1590/S1678-9946201759073
311. Tomas M, Toydemir G, Boyacioglu D, Hall RD, Beekwilder J, Capanoglu E. Processing black mulberry into jam: effects on antioxidant potential and in vitro bioaccessibility. *J Sci Food Agric*., **2017;** *97:* 3106-3113. DOI: 10.1002/jsfa.8152
312. Abd El-Hady AM. Elghalid OA, Elnagar SA. Antioxidative effects of dietary black mulberry (*Morus nigra*) fruit juice in Muscovy ducks under high ambient temperature. *Egypt Poult Sci J*., **2017;** *37:* 815-831. [Google scholar]
313. Youssef FS, Labib RM, Eldahshan OA, Singab ANB. Synergistic Hepatoprotective and Antioxidant Effect of Artichoke, Fig, Blackberry Herbal Mixture on HepG2 Cells and Their Metabolic Profiling Using NMR Coupled with Chemometrics. *Chem Biodivers*., **2017;** *14:* e1700206. DOI: 10.1002/cbdv.201700206
314. Nesello LA, Beleza ML, Mariot M, Mariano LN, De Souza P, Campos A, Cechinel-Filho V, Andrade SF, da Silva LM. Gastroprotective value of berries: Evidences from methanolic extracts of *Morus nigra* and *Rubus niveus* fruits. *Gastroenterol Res Prac*., **2017;** 7089697. DOI: 10.1155/2017/7089697
315. Dalmagro AP, Camargo A, Zeni AL. *Morus nigra* and its major phenolic, syringic acid, have antidepressant-like and neuroprotective effects in mice. *Metab Brain Dis*., **2017;** *32:* 1963-1973. DOI: 10.1007/s11011-017-0089-y
316. Souza GR, Oliveira RG, Diniz TC, Branco A, Lima SR, Guimarães AL, Oliveira AP, Pacheco AG, Silva MG, Moraes MO, Costa MP. Assessment of the antibacterial, cytotoxic and antioxidant activities of *Morus nigra* L. (Moraceae). *Braz J Biol*., **2017;** *78:* 248-254. DOI: 10.1590/1519-6984.05316
317. Issa NK, Abd-Aljabar RS. Phytochemical analysis, antioxidant (DNA Nicking Assay) and antibacterial activities of *Morus nigra* L. fruits secondary metabolites. *Sci J Univ Zakho*., **2017;** *5:* 198-204. DOI: 10.25271/2017.5.2.368
318. Budiman A, Aulifa DL, Kusuma AS, Sulastri A. Antibacterial and Antioxidant Activity

of Black Mulberry (*Morus nigra* L.) Extract for Acne Treatment. *Pharmacog J*., **2017;** *9:* 611-614. DOI: 10.5530/pj.2017.5.97

319. Okatan V. Phenolic compounds and phytochemicals in fruits of black mulberry (*Morus nigra* L.) genotypes from the Aegean region in Turkey. *Folia Hort*., **2018;** *30:* 93-101. DOI: 10.2478/fhort-2018-0010
320. Zoofishan Z, Hohmann J, Hunyadi A. Phenolic antioxidants of *Morus nigra* roots, and antitumor potential of morusin. *Phytochem Rev*., **2018;** *17:* 1031-1045. DOI: 10.1007/s11101-018-9565-1
321. Lúcio K, Rabelo AC, Araújo CM, Brandão GC, de Souza GH, da Silva RG, de Souza DM, Talvani A, Bezerra FS, Cruz Calsavara AJ, Costa DC. Anti-Inflammatory and Antioxidant Properties of Black Mulberry (*Morus nigra* L.) in a Model of LPS-Induced Sepsis. *Oxid Med Cell Longev*, **2018;** 5048031. DOI: 10.1155/2018/5048031
322. Deniz GY, Laloglu E, Koc K, Nadaroglu H, Geyikoglu F. The effect of black mulberry (*Morus nigra*) extract on carbon tetrachloride-induced liver damage. *Arch Biol Sci*., **2018;** *70:* 371-378. DOI: 10.2298/ABS171009055D
323. Singh S, Tripathi A, Lal VK, Singh D. In Vitro Antioxidant Activity and Preliminary Phytochemical Screening of *Morus nigra*. *Der Pharm Chem*., **2019;** *11:* 25-30. [Journal website]
324. Yigitaslan S, Acikgoz A, Balci Alparslan G, Toprak C, Goger F, Sahin F, Ozkaraman A. Therapeutic Potential of *Morus Nigra* on 5-Fluorouracil-İnduced Gastrointestinal Mucositis in Rats, *Osmangazi J Med*., **2019;** *42:* 363-372. DOI: 10.20515/otd.549371
325. Yazdankhah S, Hojjati M, Azizi MH. The Antidiabetic Potential of Black Mulberry Extract-Enriched Pasta through Inhibition of Enzymes and Glycemic Index. *Plant Foods Hum Nutr*., **2019;** *74:* 149-155. DOI: 10.1007/s11130-018-0711-0
326. Hago S, Mahrous EA, Moawad M, Abdel-Wahab S, Abdel-Sattar E. Evaluation of antidiabetic activity of *Morus nigra* L. and *Bauhinia variegata* L. leaves as Egyptian remedies used for the treatment of diabetes. *Nat Prod Res*., **2019;** *35:* 829-835. DOI: 10.1080/14786419.2019.1601094
327. Budiman A, Praditasari A, Rahayu D, Aulifa DL. Formulation of Antioxidant Gel from Black Mulberry Fruit Extract (*Morus nigra* L.). *J Pharm Bioallied Sci*., **2019;** *11:* 216-222. DOI: 10.4103/jpbs.JPBS_57_18
328. Suttisansanee U, Charoenkiatkul S, Jongruaysup B, Tabtimsri S, Siriwan D, Temviriyanukul P. Mulberry Fruit Cultivar 'Chiang Mai' Prevents Beta-Amyloid Toxicity in PC12 Neuronal Cells and in a *Drosophila* Model of Alzheimer's Disease.

Molecules, **2020;** *25:* 1837. DOI: 10.3390/molecules25081837

329. Cui WS, Zhang Q, Zhao XH. Impact of heat treatment on anti-oxidative and anti-colon cancer activities of the soluble extracts from black mulberry (*Morus nigra* L.) using water and ethanol-water solvents. *RSC Adv.*, **2020;** *10:* 30415-30427. DOI: 10.1039/d0ra05598k
330. Roussos PA, Denaxa NK, Ntanos E, Tsafouros A, Mavrikou S, Kintzios S. Organoleptic, nutritional and anti-carcinogenic characteristics of the fruit and rooting performance of cuttings of black mulberry (*Morus nigra* L.) genotypes. *J Berry Res.*, **2020;** *10:* 77-93. DOI: 10.3233/JBR-190422
331. Erden Y. Sour black mulberry (*Morus nigra* L.) causes cell death by decreasing mutant p53 expression in HT-29 human colon cancer cells. *Food Biosci.*, **2021;** *42:* 101113. DOI: 10.1016/j.fbio.2021.101113
332. Vega EN, Molina AK, Pereira C, Dias MI, Heleno SA, Rodrigues P, Fernandes IP, Barreiro MF, Stojković D, Soković M, Carocho M, Barreira JC, Ferreira IC, Barros L. Anthocyanins from *Rubus fruticosus* L. and *Morus nigra* L. Applied as Food Colorants: A Natural Alternative. *Plants.*, **2021; 10:** 1181. DOI: 10.3390/plants10061181
333. Skrovankova S, Ercisli S, Ozkan G, Ilhan G, Sagbas HI, Karatas N, Jurikova T, Mlcek J. Diversity of Phytochemical and Antioxidant Characteristics of Black Mulberry (*Morus nigra* L.) Fruits from Turkey. *Antioxidants*, **2022;** *11:* 1339. DOI: 10.3390/antiox11071339
334. Nur S, Sami FJ, Marwati, Nursamsiar, Fadri A, Khairuddin K. Phenolic and Flavonoid Content of Black Mulberry (*Morus nigra* L.) Stem and Their Evaluation Antioxidant and Cytotoxic Profile. *Borneo J Pharm.*, **2022;** *5:* 384-395. DOI: 10.33084/bjop.v5i4.3760
335. Melo RS, Reis SA, Guimarães AL, Silva ND, Rocha JM, El Aouad N, Almeida JR. Phytocosmetic Emulsion Containing Extract of *Morus nigra* L. (Moraceae): Development, Stability Study, Antioxidant and Antibacterial Activities. *Cosmetics*, **2022;** *9:* 39. DOI: 10.3390/cosmetics9020039
336. Vukmirović S, Ilić V, Tadić V, Čapo I, Pavlović N, Tomas A, Paut Kusturica M, Tomić N, Maksimović S, Stilinović N. Comprehensive Analysis of Antioxidant and Hepatoprotective Properties of *Morus nigra* L. *Antioxidants*, **2023;** *12:* 382. DOI: 10.3390/antiox12020382
337. Almutairi BO, Alsayadi AI, Abutaha N, Al-Mekhlafi FA, Wadaan MA. Evaluation of the Anticancer Potential of *Morus nigra* and *Ocimum basilicum* Mixture against

Different Cancer Cell Lines: An In Vitro Evaluation. *Biomed Res Int*., **2023;** 9337763. DOI: 10.1155/2023/9337763

338. Tkachenko A. Study of antioxidant properties of organic dried black mulberry. *Technol Audit Prod Reserves*, **2024;** *4:* 46-50. DOI: 10.15587/2706-5448.2024.310427
339. Öz YG, Naharci MI, Rakıcıoğlu N, Göktaş Z. Effect of Black Mulberry (*Morus nigra*) Consumption on Antioxidant Capacity and Inflammation in Patients Mild-to-Moderate Alzheimer's Dementia: A Randomized Clinical Pilot Study. *Akad Gıda*, **2025;** *23:* 173-183. DOI: 10.24323/akademik-gida.1786112
340. Özgen M, Serçe S, Kaya C. Phytochemical and antioxidant properties of anthocyanin-rich *Morus nigra* and *Morus rubra* fruits. *Sci Hortic*., **2009;** *119:* 275-279. DOI: 10.1016/j.scienta.2008.08.007
341. Ercisli S, Tosun M, Duralija B, Voća S, Sengul M, Turan M. Phytochemical Content of Some Black (*Morus nigra* L.) and Purple (*Morus rubra* L.) Mulberry Genotypes. *Food Technol Biotechnol*, **2010;** *48:* 102-106. [ResearchGate]
342. Koca I, Ustun NS, Koca AF, Karadeniz B. Chemical composition, antioxidant activity and anthocyanin profiles of purple mulberry (*Morus rubra*) fruits. *J Food Agric Environ*, **2008;** *6:* 39-42. [ResearchGate]
343. Turan I, Demir S, Kilinc K, Aliyazicioglu Y, Alver A, Misir S, Yaman SO, Akbulut K, Mentese A, Deger O. *Morus rubra* Extract Induces G1 Cell Cycle Arrest and Apoptosis in Human Lung and Prostate Cancer Cells. *Indian J Pharm Edu Res*., **2017;** *51:* 51-58. DOI: 10.5530/ijper.51.1.8
344. Lim WM, Teo SS. Identification of antioxidant properties of *Morus rubra*. *Int J Complement Alt Med*., **2019;** *12:* 31-34 DOI: 10.15406/ijcam.2019.12.00445
345. Tan YX, Liu C, Chen RY. 2-Arylbenzofuran derivatives from *Morus wittiorum*. *Acta Pharm Sinica*, **2008;** *43:* 1119-1122. [ResearchGate, article in Chinese]
346. Tan YX, Yan RY, Wang HQ, Chen RY, Yu DQ. Wittiorumins A - F, antioxidant diels-alder-type adducts from *Morus wittiorum*. *Planta Med*., **2009;** *75:* 249-255. DOI: 10.1055/s-0028-1112202
347. Tan YX, Liu C, Zhang T, Chen RY, Yu DQ. Bioactive constituents of *Morus wittiorum*. *Phytochem Lett*., **2010;** *3:* 57-61. DOI: 10.1016/j.phytol.2009.11.006
348. Tan YX, Yang Y, Zhang T, Chen RY, Yu DQ. Bioactive 2-arylbenzofuran derivatives from *Morus wittiorum*. *Fitoterapia*, **2010;** *81:* 742-746. DOI: 10.1016/j.fitote.2010.03.017
349. Tan YX, Gong T, Liu C, Chen RY, Yu DQ. Five new 2-arylbenzofuran derivatives

from *Morus wittiorum*. *Chem Pharm Bull*., **2010;** *58:* 579-581. DOI: 10.1248/cpb.58.579

350. Cui XQ, Wang L, Yan RY, Tan YX, Chen RY, Yu DQ. A new Diels-Alder type adduct and two new flavones from the stem bark of *Morus yunanensis* Koidz. *J Asian Nat Prod Res*., **2008;** *10:* 361-366. DOI: 10.1080/10286020701833537
351. Cui XQ, Wang HQ, Liu C, Chen RY. Study of anti-oxidant phenolic compounds from stem barks of *Morus yunanensis*. *Chin J Chin Mater Med*., **2008;** *33:* 1569-1572. [PMID: 18837317, article in Chinese]
352. Reddy AR, Chaitanya KV, Sundar D. Water stress-mediated changes in antioxidant enzyme activities of mulberry (*Morus alba* L.). *J Seric Sci Jpn*., **2000;** *69:* 169-175. DOI: 10.11416/kontyushigen1930.69.169
353. Tan JJ, Lim YY, Siow LF, Tan JB. Effects of Drying on Polyphenol Oxidase and Antioxidant Activity of *Morus alba* Leaves. *J Food Process Preserv*, **2015;** *39:* 2811-2819. DOI: 10.1111/jfpp.12532
354. Xiaofeng Y, Shuang Z, Li Z, Dan W, Xiaoman F, Zhen O. Effect of frost on flavonol glycosides accumulation and antioxidant activities of mulberry (*Morus alba* L.) leaves. *Pharmacog Mag*., **2019;** *15:* 466-472. DOI: 10.4103/pm.pm_493_18
355. Bajpai PK, Warghat AR, Dhar P, Kant A, Srivastava RB, Stobdan T. Variability and relationship of fruit color and sampling location with antioxidant capacities and bioactive content in *Morus alba* L. fruit from trans-Himalaya, India. *LWT Food Sci Technol*, **2014;** *59:* 981-988. DOI: 10.1016/j.lwt.2014.07.055
356. Hao JY, Wan Y, Yao XH, Zhao WG, Hu RZ, Chen C, Li L, Zhang DY, Wu GH. Effect of different planting areas on the chemical compositions and hypoglycemic and antioxidant activities of mulberry leaf extracts in Southern China. *PLoS One*., **2018;** *13:* e0198072. DOI: 10.1371/journal.pone.0198072
357. Zhu W, Zhong Z, Liu S, Yang B, Komatsu S, Ge Z, Tian J. Organ-Specific Analysis of *Morus alba* Using a Gel-Free/Label-Free Proteomic Technique. *Int J Mol Sci*., **2019;** *20:* 365. DOI: 10.3390/ijms20020365
358. Hu J, Dai X, Sun J. Morphological and physiological responses of *Morus alba* seedlings under different light qualities. *Not Bot Horti Agrobo*, **2016;** *44:* 382-392. DOI: 10.15835/nbha44210486
359. Misra AK, Das BK, Datta JK, De GC. Influence of antitranspirants on photosynthesis, leaf dry wt., nitrate reductase activity and leaf yield of mulberry (*Morus alba* L.) under water stress condition. *Indian J Agric Res*., **2009;** *43:* 144-147. [Journal website]

360. Lee Y, Hwang KT. Changes in physicochemical properties of mulberry fruits (*Morus alba* L.) during ripening. *Sci Hortic*., **2017;** *217:* 189-196. DOI: 10.1016/j.scienta.2017.01.042
361. Lu N, Luo Z, Ke Y, Dai L, Duan H, Hou R, Cui B, Dou S, Zhang Y, Sun Y, Li Y. Growth, physiological, biochemical, and ionic responses of *Morus alba* L. seedlings to various salinity levels. *Forests*, **2017;** *8:* 488. DOI: 10.3390/f8120488
362. Qin F, Liu G, Huang G, Dong T, Liao Y, Xu X. Zinc application alleviates the adverse effects of lead stress more in female *Morus alba* than in males. *Environ Exp Bot*., **2018;** *146:* 68-76. DOI: 10.1016/j.envexpbot.2017.10.003
363. Chen C, Mokhtar RAM, Sani MSA, Noor NQIM. The Effect of Maturity and Extraction Solvents on Bioactive Compounds and Antioxidant Activity of Mulberry (*Morus alba*) Fruits and Leaves. *Molecules*, **2022;** *27:* 2406. DOI: 10.3390/molecules27082406
364. Yu Y, Xu Y, Wu J, Xiao G, Fu M, Zhang Y. Effect of ultra-high pressure homogenisation processing on phenolic compounds, antioxidant capacity and anti-glucosidase of mulberry juice. *Food Chem*., **2014;** *153:* 114-120. DOI: 10.1016/j.foodchem.2013.12.038
365. Wang F, Du BL, Cui ZW, Xu LP, Li CY. Effects of high hydrostatic pressure and thermal processing on bioactive compounds, antioxidant activity, and volatile profile of mulberry juice. *Food Sci Technol Int*., **2017;** *23:* 119-127. DOI: 10.1177/1082013216659610
366. Guha A, Sengupta D, Rasineni GK, Reddy AR. An integrated diagnostic approach to understand drought tolerance in mulberry (*Morus indica* L.). *Flora*., **2010;** *205:* 144-151. DOI: 10.1016/j.flora.2009.01.004
367. Saracoglu O. Phytochemical accumulation of anthocyanin rich mulberry (*Morus laevigata*) during ripening. *Food Meas*., **2018;** *12:* 2158-2163. DOI: 10.1007/s11694-018-9831-3
368. Nguyen CL, Nguyen HV. Ultrasonic effects on the quality of mulberry juice. *Beverages*, **2018;** *4:* 56. DOI: 10.3390/beverages4030056
369. Charunuch C, Tangkanakul P, Rungchang S, Sonted V. Application of mulberry (*Morus alba*) for supplementing antioxidant activity in extruded Thai rice snack. *Kasetsart J Nat Sci*., **2008;** *42:* 79-87. [Journal website]
370. Przeor M, Ahmed NM. Technological processing of Phaseolus vulgaris and *Morus alba* leaves to create a new nutritional food product for individuals with diabetes. *Sci Rep*., **2024;** *14:* 28686. DOI: 10.1038/s41598-024-80373-7

371. Go EJ, Ryu BR, Gim GJ, Lee HY, You HS, Kim HB, Lee HT, Lee JY, Shim MS, Baek JS, Lim JD. Hot-Melt Extrusion Enhances Antioxidant Effects of Mulberry on Probiotics and Pathogenic Microorganisms. *Antioxidants*, **2022;** *11:* 2301. DOI: 10.3390/antiox11112301
372. Li Q, Chen Z, Yu Y, Zou Y, Liao S, Hu T. Sugar degradation process of mulberry (*Morus alba* L.) fruit was developed with microbial biotransformation. *J Food Process Eng*., **2018;** *41:* e12631. DOI: 10.1111/jfpe.12631
373. Ammar AA. A Study on The Preventive Effect of Mulberry (*Morus alba* l.) Fruits in Rats Exposed to Gamma Radiation. Egypt J Hosp Med., **2015;** *61:* 383-388. DOI: 10.12816/0017691
374. Zhang J, Chen C, Fu X. The *Fructus mori* L. polysaccharide-iron chelates formed by self-embedding with iron(iii) as the core exhibit good antioxidant activity. *Food Funct*, **2019;** *10:* 3150-3160. DOI: 10.1039/c9fo00540d
375. Lee NK, Jeong JH, Oh J, Kim Y, Ha YS, Jeong YS. Bioconversion of Flavonols in Mulberry Leaf. J Food Biochem, **2015;** *39:* 765-770. DOI: 10.1111/jfbc.12176
376. Nasri S, Niknami Z, Ziai SA, Roghani M, Kamalinejad M. An investigation into the effect of *Morus nigra* l. Leaf extract on parkinson's disease symptoms and oxidative stress markers in male rats. *J Vet Clin Res*., **2012;** *3:* 129-141. [Journal website, article in Persian]
377. Walia YK, Gupta DK. Periodate oxidation of *Ceiba pentandra* and *Morus nigra* purified non-cellulosic polysaccharides. *Bio Bull*., **2015;** *1:* 34-39. [ResearchGate]
378. Lim HH, Ji S, Kwak HS, Eom T, Kim M, Lee Y, Do JW, Yu S, Choi GP, Jeong JI, Jeong Y. Quality characteristics of coffee brewed from green beans soaked in mulberry (Morus bombycis) extract. *J Korean Soc Food Sci Nutr*., **2015;** *44:* 579-585. DOI: 10.3746/jkfn.2015.44.4.579
379. Deshmukh SR, Habtemariam S, Wadegaonkar PA. Antioxidant and Antiproliferative Activity of Root Suspension Culture of *Morinda citrifolia* L. *Res J Pharm Technol*, **2010;** *3:* 1189-1193. [Journal website]
380. Das D, Ghosh R, Mandal P. Biogenic synthesis of silver nanoparticles using S1 genotype of *Morus alba* leaf extract: characterization, antimicrobial and antioxidant potential assessment. *SN Appl. Sci.*, **2019;** *1:* 498. DOI: 10.1007/s42452-019-0527-z
381. Akbal A, Turkdemir MH, Cicek A, Ulug B. Relation between Silver Nanoparticle Formation Rate and Antioxidant Capacity of Aqueous Plant Leaf Extracts. *J Spectrosc*, **2016;** 4083421. DOI: 10.1155/2016/4083421

382. Sarah J. Green Synthesis, Characterization, and Evaluation of the Biological Activities of Silver Nanoparticles Synthesized from *Morus indica* (Mulberry) Fruit Extract. *World J Pharm Pharm Sci*., **2017;** *6:* 1283-1301. DOI: 10.20959/wjpps20176-9342
383. Kim HB, You HS, Ryu SJ, Lee HY, Baek JS. Green synthesis of silver nanoparticles from mulberry leaf through hot melt extrusion: Enhanced antioxidant, antibacterial, anti-inflammatory, antidiabetic, and anticancer properties. *Food Hydrocoll Health,* **2024;** *6:* 100184. DOI: 10.1016/j.fhfh.2024.100184
384. Bunghez IR, Dumitrescu O, Somoghi R, Ronita I, Ion RM. Silver Nanoparticles Obtained via *Morus Nigra* Extract. *Rev Chem*., **2015;** *66:* 1112-1115. [ResearchGate]
385. Jeon YN, Ryu SJ, Lee HY, Kim JO, Baek JS. Green Synthesis of Silver Nanoparticle Using Black Mulberry and Characterization, Phytochemical, and Bioactivity. *Antibiotics*, **2024;** *13:* 686. DOI: 10.3390/antibiotics13080686
386. Akmeşe O, Baltacı C, Gültekin E, Taşkın II, Sever MR, Derin DÇ, Karpuz Ö. Phytogenic silver and copper nanoparticles from *Morus nigra* L. leaf as multifunctional agents: antioxidant, antidiabetic, antimicrobial, and anticancer potency, *Turk J Anal Chem*., **2025:** *7:* 321-337. DOI: 10.51435/turkjac.1738363
387. Adavallan K, Prasad NR, Krishnakumar N. Antioxidant and Antifungal Potential of *Morus alba* Leaf Extract Mediated Synthesis of Gold Nanoparticles. *Int J Sci Eng Technol*, **2015;** *3:* 67-74. [ResearchGate]
388. Singh A, Singh NB, Hussain I, Singh H. Effect of biologically synthesized copper oxide nanoparticles on metabolism and antioxidant activity to the crop plants *Solanum lycopersicum* and *Brassica oleracea* var. botrytis. *J Biotechnol*, **2017;** *262:* 11-27. DOI: 10.1016/j.jbiotec.2017.09.016
389. Amel Z, Souad B, Mounira D, Wahiba M, Djahoudi A. Green synthesis of mediated *Morus alba* copper oxide nanoparticles and their photocatalytic dye degradation, antioxidant and antimicrobial studies. *Chem Pap*., **2026;** 1-8. DOI: 10.1007/s11696-026-04969-1
390. Rocha LV, Lishanthi R, Madeena BS, Hadsun JA, Rani JC. Phytosynthesis of Selenium Nanoparticles from *Morus rubra* (L.) and Evaluation of its Bioactive Potential: Antioxidant, Antimicrobial, and Anticancer. *Anticancer Agents Med Chem*., **2026;** doi: 10.2174/0118715206428455251210203908
391. Phan TN, Kim O, Ha MT, Hwangbo C, Min BS, Lee JH. Albanol B from Mulberries Exerts Anti-Cancer Effect through Mitochondria ROS Production in Lung Cancer Cells and Suppresses In Vivo Tumor Growth. *Int J Mol Sci*., **2020;** *21:* 9502. DOI:

10.3390/ijms21249502

392. Amézqueta S, Galán E, Fuguet E, Carrascal M, Abián J, Torres JL. Determination of D-fagomine in buckwheat and mulberry by cation exchange HPLC/ESI-Q-MS. *Anal Bioanal Chem*., **2012;** *402:* 1953-1960. DOI: 10.1007/s00216-011-5639-2
393. Fang C, Zhang BB, Lin-Han, Gao CF, Min-Wang. d-Fagomine Attenuates High Glucose-Induced Endothelial Cell Oxidative Damage by Upregulating the Expression of PGC-1α. *J Agric Food Chem*., *2018; 66:* 2758-2764. DOI: 10.1021/acs.jafc.7b05942
394. Méndez L, Muñoz S, Barros L, Miralles-Pérez B, Romeu M, Ramos-Romero S, Torres JL, Medina I. Combined Intake of Fish Oil and D-Fagomine Prevents High-Fat High-Sucrose Diet-Induced Prediabetes by Modulating Lipotoxicity and Protein Carbonylation in the Kidney. *Antioxidants*, **2023;** *12:* 751. DOI: 10.3390/antiox12030751
395. Liu Y, Fu H, Ma J, Wang Y, Shi Z, Liu Y, Huang X, Han B, Li J. Kuwanon A from *Morus alba* L. Alleviates H_2O_2-Induced Oxidative Damage in HaCaT Keratinocytes by Inhibiting Ferroptosis and Enhancing Antioxidant Capacity. *Antioxidants*, **2026;** *15:* 657. DOI: 10.3390/antiox15060657
396. Pothinuch P, Tongchitpakdee S. Melatonin contents in mulberry (*Morus* spp.) leaves: Effects of sample preparation, cultivar, leaf age and tea processing. *Food Chem*., **2011;** *128:* 415-419. DOI: 10.1016/j.foodchem.2011.03.045
397. Jagtap SG, Khyade VB. Oxidative Stress Reducing Capabilities of Moracin, the Novel Compound from the Fruits of Mulberry, *Morus alba* (L) in Hydrogen Peroxide Induced Stress in Skin Fibroblast Cell Line Culture (AH927). *Asian J Sci Technol*, **2018;** *9:* 8126-8133. [Journal website]
398. Tu J, Shi D, Wen L, Jiang Y, Zhao Y, Yang J, Liu H, Liu G, Yang B. Identification of moracin N in mulberry leaf and evaluation of antioxidant activity. *Food Chem Toxicol*., **2019;** *132:* 110730. DOI: 10.1016/j.fct.2019.110730
399. Boulebd H. Theoretical Insights into the Antioxidant Activity of Moracin T, Free Radic Res., **2020;** *54:* 221-230. DOI: 10.1080/10715762.2020.1747616
400. Yin XL, Lv Y, Wang S, Zhang YQ. Morusin suppresses A549 cell migration and induces cell apoptosis by downregulating the expression of COX-2 and VEGF genes. *Oncol Rep*., **2018;** *40:* 504-510. DOI: 10.3892/or.2018.6431
401. Gupta G, Chellappan DK, Agarwal M, Ashwathanarayana M, Nammi S, Pabreja K, Dua K. Pharmacological Evaluation of the Recuperative Effect of Morusin Against Aluminium Trichloride ($AlCl_3$)-Induced Memory Impairment in Rats. *Cent Nerv Syst*

Agents Med Chem., **2017;** *17:* 196-200. DOI: 10.2174/1871524917666161111095335

402. Likhitwitayawuid K. Oxyresveratrol: Sources, Productions, Biological Activities, Pharmacokinetics, and Delivery Systems. *Molecules*, **2021;** *26:* 4212. DOI: 10.3390/molecules26144212
403. Sabater-Jara AB, Almagro L, Nicolás Sánchez I, Pedreño MÁ. Biotechnological Approach to Increase Oxyresveratrol Production in Mulberry In Vitro Plants under Elicitation. *Plants*., **2023;** *12:* 546. DOI: 10.3390/plants12030546