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PREPARATION, STANDARDIZATION AND EVALUATION OF ANTIPYRETIC EFFECT (IN VIVO) OF MADHUKADI KWATHA AND ITS SYRUP

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ABSTRACT

Background: Kwatha Kalpana is one of the five primary dosage forms in Ayurveda. However, its bitter taste, short shelf life, and tedious preparation make it less acceptable in modern practice. Converting Kwatha into a syrup formulation can enhance palatability, stability, and patient compliance. **Objective:** To prepare and standardize Madhukadi Kwatha and its syrup, and to evaluate their antipyretic activity in vivo. **Methods:** Madhukadi Kwatha was prepared as per classical Ayurvedic references and converted into syrup form by adding sugar base and preservatives. Both formulations were subjected to physicochemical and analytical evaluation. Antipyretic activity was assessed in Wistar albino rats using the yeast-induced pyrexia model. Observations were statistically analysed. **Results:** Standardization confirmed that both formulations met acceptable physicochemical parameters. Organoleptic characters of the syrup showed improved palatability. In the animal study, both Kwatha and syrup produced significant reduction in rectal temperature compared with control. The effect was comparable to the standard antipyretic drug, with the syrup showing better compliance due to improved acceptability. **Conclusion:** Madhukadi Kwatha and its syrup demonstrated significant antipyretic potential in preclinical models. The syrup form offers advantages of palatability

and convenience, making it a patient-friendly alternative without compromising therapeutic efficacy.

KEYWORDS: Madhukadi Kwatha, Madhukadi Kwatha Syrup, Syrup, Antipyretic, Standardization, Ayurveda.

INTRODUCTION

Ayurveda, regarded as an *Upaveda* of the Atharvaveda, has been practiced since the Vedic period as a holistic system of healing. In the early *Samhita* period, plant parts such as roots, bark, fruits, and seeds were used fresh for treatment. But because herbs were not always available year-round, methods for drying and storing them were developed, leading to the evolution of *Panchavidha Kashaya Kalpana*. Among these, *Kwatha* (herbal decoction) became one of the most widely used forms.

Although *Kwatha* is effective, its bitter taste, tedious preparation, and short shelf life make it less practical for today's lifestyle. To address these issues, dosage forms like *Ghana, Asava, Arishta,* and syrups were developed. Syrup improves palatability and stability, making it especially suitable for children and elderly patients.

Jwara (fever) is described in Ayurveda as the foremost of all diseases and remains one of the most common symptoms seen in medical practice. While many *Jwaraghna yogas* are mentioned in classical texts, there is still a need for antipyretic formulations that are both effective and patient-friendly. With this background, the present study was designed to convert Madhukadi Kwatha into syrup form and evaluate its preclinical antipyretic efficacy.

AIMS AND OBJECTIVES

Aims

1. Preparation and standardization of madhukadikwatha and its Syrup.
2. Evaluation of antipyretic effect of madhukadi kwatha and its Syrup preclinically.

Objectives

1. Literature survey of madhukadikwatha.
2. Prepare madhukadikwatha and its conversion into syrup.
3. Analyze both the products physico-chemically to develope the standards.
4. Determine the antipyretic activity of developed products on animal models.

MATERIALS AND METHODS

A. Pharmaceutical Study

I] Preparation of madhukadi kwatha (MK)

Reference: मधुकं चन्दनं मुस्तं धात्री धन्यमुशिरकम्।
छिन्नोद्भवं पटोलश्च क्वाथः समधुशर्करा ॥
ज्वरमष्टविधं हन्ति सन्ततादय सुदारुणम्।
वातिकं पेत्तिकश्चैव श्लेष्मिकम् सन्निपतिकम् ॥

- Bhaishajya Ratnavali[1]

Sr.No.	Contents	Proportion	Quantity
1	Yashtimadhu bharad (Glycerhhiza glabra)	1 Part	62.5 gm
2	Rakta Chandan bharad (Pterocarpus santalinus)	1 Part	62.5 gm
3	Nagarmotha bharad (Cyperus rotundus)	1 Part	62.5 gm
4	Amalki bharad (Emblica officinalis)	1 Part	62.5 gm
5	Dhanyak bharad (Coriandrum sativum)	1 Part	62.5 gm
6	Ushir bharad (Vetveria zizaniodis)	1 Part	62.5 gm
7	Guduchi bharad (Tinospora cordifolia)	1 Part	62.5 gm
8	Patol bharad (Tricosanthes dioca)	1 Part	62.5 gm
9	Madhu (Honey)	1/8th Part	125 gm
10	Sharkara (sugar)	1/8th Part	125 gm
11	Jal (water)	16 Part	8 L

Step 1- All the above-mentioned authenticated contents were converted in to bharad form (coarse powder) by using pulverizer of mesh size 40.

Step 2- All these contents were taken in SS vessel as per the declared proportion, 16 parts of water was added into it and the mixture was kept overnight for soaking.

Step 3- After 12 hrs. The above mixture was stirred well with the help of stirrer. This mixture was kept on the low flame of gas segari. The temperature of the mixture was maintained. The temperature of mixture was monitored 1 hourly with the help of pyrometer. The heating procedure was continued till the water content of the formulation gets reduced up to 1/8th part.

Step 4- After completion of heating process, the mixture was filtered with the help of white cotton cloth to get MK. When filtered kwath was hot dissolve 1/8th part of sugar in it, preparation allow to cool down naturally and then 1/8th part honey were added.

Thus, prepared MK was subjected for physicochemical analysis and TLC.

Total three batches of same formulation were prepared for standardization of research drug by following the same manufacturing method.

Fig. 1: All 8 herbs required for MK preparation.

Fig 2: Bharad of Mix Drugs for MK + water, started boiling.

Fig. 3: Boiling procedure of MK, filtering of MK with cotton cloth, remaining residue of kwatha.

Fig. 4: Adding 1/8th of sugar and 1/8th of honey in total amount of MK.

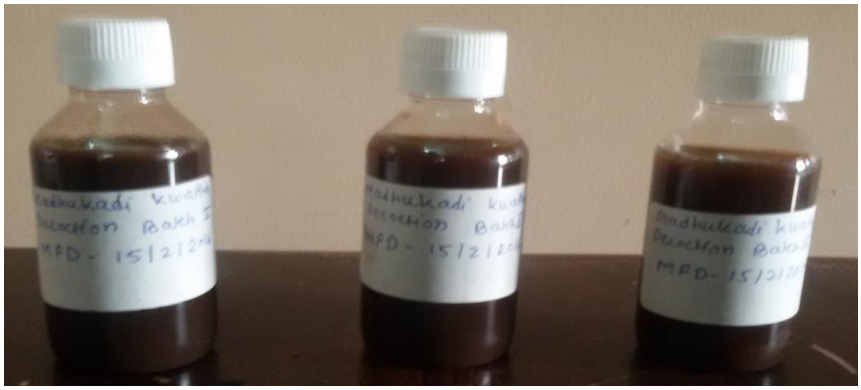

Fig. 5: prepared MK three batches stored in sterile plastic bottles.

II] Preparation of madhukadi kwatha syrup (MKS)

Contents:

Sr.No.	Contents	Proportion	Quantity
1	*Yashtimadhu bharad* (Glycerhhiza glabra)	1 Part	62.5g
2	*Rakta Chandan bharad* (Pterocarpus santalinus)	1 Part	62.5g
3	*Nagarmotha bharad* (Cyperus rotundus)	1 Part	62.5g
4	*Amalki bharad* (Emblica officinalis)	1 Part	62.5g
5	*Dhanyak bharad* (Coriandrum sativum)	1 Part	62.5g
6	*Ushir bharad* (Vetveria zizaniodis)	1 Part	62.5g
7	*Guduchi bharad* (Tinospora cordifolia)	1 Part	62.5g
8	*Patol bharad* (Tricosanthes dioca)	1 Part	62.5g
9	Madhu (Honey)	1/8th Part	125g
10	Sharkara (sugar)	40% 0f syrup	400g
11	Jal (water)	16 Parts	8L
12	Sodium benzoate	0.1% of syrup	(Q.S.)

Step 1- All the above-mentioned authenticated contents were converted in to bharad form (coarse powder) by using pulverizer of mesh size 40.

Step 2- All these contents were taken in SS vessel as per the declared proportion, 16 parts of water was added into it and the mixture was kept overnight for soaking.

Step 3 - After 12 hrs. The above mixture was stirred well with the help of stirrer. This mixture was kept on the low flame of gas segari. The temperature of the mixture was maintained. The temperature of mixture was monitored 1 hourly with the help of pyrometer. The heating procedure was continued till the water content of the formulation gets reduced up to 1/8th part.

Step 4 - After completion of heating process, the mixture was filtered with the help of white cotton cloth to get MKS. Then filtered kwath subjected to low heat just to dissolve 40% of sugar and get syrup consistency to it, also add 0.1% sodium benzoate as preservative. Preparation allow to cool down naturally and then 1/8th part honey were added. Thus, prepared MKS was subjected for physicochemical analysis and TLC.

Total three batches of same formulation were prepared for standardization of research drug by following the same manufacturing method.

Fig. 6: Preparation of MKS 16 times water + drug, boiling procedure.

Fig. 7: Filteration of MKS, residue after filteration.

Fig. 8: Preparation of MKS from MK, 40% of sugar addition of total amount of MK including 1/8th amont in MK, Adding 0.1% of sodium benzoate in total amount MKS, Adding honey after cooling down the syrup.

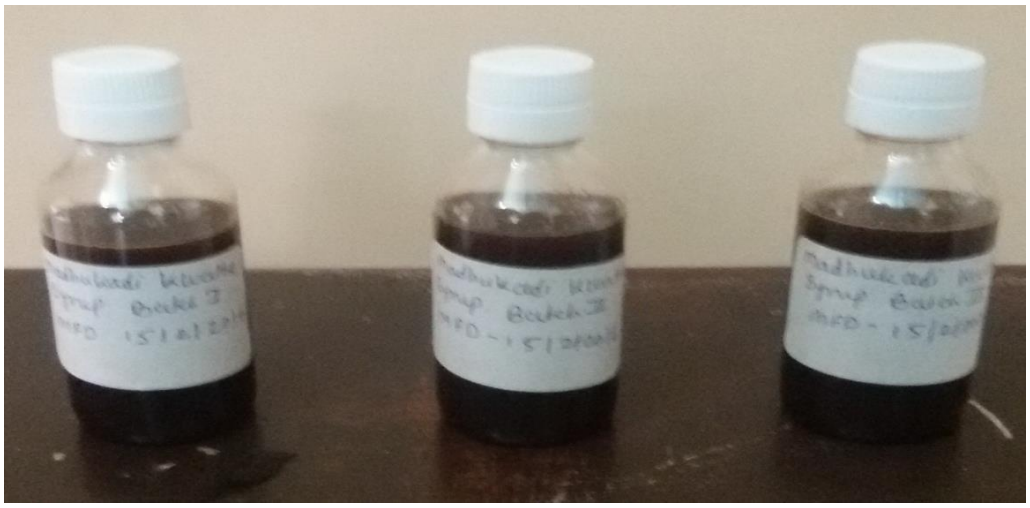

Fig. 9: prepared MK three batches stored in sterile plastic bottles.

B. Analytical Study[2]

I] Methods used for analytical study of MK-I, MK-II and MK-III

Sr. No.	*Panchabhoutik parikshana*	Chemical analysis
1	*Shabda*	Total Ash %
2	*Sparsha*	Acid Insoluble Ash %
3	*Roopa*	Water Soluble Extract %

4	*Rasa*	Alcohol Soluble Extract %
5	*Gandha*	Loss on drying
6	-	Sugar %
7	-	Refractive Index
8	-	pH
9	-	Sp. Gravity
10	-	Density (gm/cm^3)
11	-	TLC

II] Methods used for analytical study of MKS-I, MKS-II, MKS-III

Sr. No.	***Panchabhoutik parikshana***	**Chemical analysis**
1	*Shabda*	Total Ash %
2	*Sparsha*	Acid Insoluble Ash %
3	*Roopa*	Water Soluble Extract %
4	*Rasa*	Alcohol Soluble Extract %
5	*Gandha*	Loss on drying
6	-	Sugar %
7	-	Refractive Index
8	-	pH
9	-	Sp. Gravity
10	-	Density (gm/cm^3)
11	-	TLC
12	-	Viscocity (cps)

C. Anti-microbial study (for stability)

Total Plate Count and Total Yeast & Mold Count done for only one batch of MK and MKS but for different three days

1. MK- 0 day, 1st day, 2nd day
2. MKS- 0 day 1st month, 2nd month

D. Preclinical Study

Study Location

The experimental study was conducted in the Department of Pharmacology, Bombay Veterinary College, Parel, Mumbai.

Animals

Healthy adult Wistar albino rats (170–200 g, 90–120 days old, both sexes) were procured from the Central Animal House, Bombay Veterinary College. Animals were housed in polypropylene cages with paddy husk bedding, under standard conditions (24 ± 2 °C, 12 h light/dark cycle). They were provided standard pellet diet and water.

Induction of Pyrexia

Pyrexia was induced by intraperitoneal injection of 20% baker's yeast suspension (0.135 g/kg body weight) prepared in normal saline, as per Tomazetti et al. (2005).

Dose fixation of trial drug

Recommended human dose of *madhukadi kwatha* (according to *sharangdhar samhita)* is *2 pala matra* it means 8 *tola* = 80 ml. Syrup is also of same dose for comparative study

This dose is converted with rats dose with the formula

Rat Dose= Human Dose X 0.018/200 Gm. Of The Body Weight.

If rat's weight is 200 gm. then

Rat dose = 80 X 0.018 = 1.44 ml

Standard drug

Paracetamol suspension was made with distilled water which is standard drug for the experiment. The suspension was administrated orally. After referring the human dose, rat dose was fixed as 150 mg./kg BW.

Grouping and Treatment

Twenty-four rats were randomly divided into four groups (n=6):

- Group I (Placebo): Distilled water
- Group II (Standard): Paracetamol 150 mg/kg BW
- Group III (Test 1): Madhukadi Kwatha (1.44 ml/200 g BW, human equivalent dose)
- Group IV (Test 2): Madhukadi Kwatha Syrup (same equivalent dose)

Drugs were administered orally using an intragastric feeding tube 5 hours after pyrexia induction.

MATERIALS AND METHODS

Collection of trial drugs: Madhukadi kwatha and its syrup was prepared for the present study in department of rasshastra and bhaishajya kalpana in college institute.

Materials: Wistar albino rats.

Drugs and chemicals: Madhukadi kwatha and syrup

Equipment: Digital animal weighing balance, Milligram digital weighing machine, Mortar and pestle, 2 ml. And 5 ml. Syringes, Gavage needle for intragastric oral administration, Digital thermometer.

METHOD

Pre-procedures: - • Rats were grouped.

- Weighed.
- General examination of rats was done.
- The animals were fasted overnight prior to the experiment. Vehicle administration of drug

For standard dose: 2 ml of distilled water, Trial drug and standard drug suspension was made in their vehicle at calculated dose.

Administration of drugs: - Drug was administrated through intragastric tube using 2 ml. Syringe fitted with 18 gauze needles made of still provided with number of infants feeding tube to avoid injury to the rats during administration. Prescribed drug was loaded in syringe and the tube was inserted in to the oesophagus. After confirming that the tube was inside the oesophagus, drug was pushed slowly to reach the gastrum.

Temperature Recording

Rectal temperature was measured using a digital thermometer inserted 2.8 cm into the rectum. Readings were taken at baseline (before yeast injection), after 5 hours (pyrexia confirmation), and subsequently at 1, 2, 3, and 4 hours after drug administration.

Temperature of pyrexia induced rats were recorded each hour after induction of pyrexia and till 7 hrs after treatment.

Protocol of Animal Study

Group	no of animals	Induction of pyrexia	Treatment	Sacrifice
1	6	Yes	No treatment	No
2	6	Yes	Paracetamol @ 150 mg/kg BW.+ 2 ml distilled water	No
3	6	Yes	*Madhukadi kwatha* 7.2 ml/kg BW.	No
4	6	Yes	*Madhukadi kwatha* syrup 7.2 ml/kg BW	No

OBSERVATIONS

- Animals were monitored for general behavior, clinical signs, and temperature changes.
- Antipyretic effect was assessed by comparing reduction in rectal temperature across groups.

Fig. No. 10 - Photographic presentation of antipyretic study.

I- cages of animals of all groups,

II- weighng and marking of animals,

III- inducing pyrexia with help of yeast,

IV- animals after pyrexia,

V-mesuring temperature after pyrexia induced,

VI- giving standard drug paracetamol,

VII-giving test drug MK and MKS,

VIII- temperature recording after treatment,

IX- After reducing the pyrexia animals.

OBSERVATIONS AND RESULTS

I] OBSERVATION OF PHARMACEUTICAL AND ANALYTICAL STUDY

I. A. Preperation Of Mk

Mass balance of raw materials after conversion in bharad

These raw materials were pulverised in the pharmacy of institute itself for further use and observations has been mentioned in table.

Table No. 1: Mass balance of raw materials after conversion in bharad (coarse).

Sr. No.	Stage	I	II	III	IV	V	VI	VII	VIII
1.	Raw form (Kg)	1	1	1	1	1	1	1	1
2.	Coarse form (gm)	850	890	870	910	900	820	860	875
3.	Loss (%)	15	11	13	9	10	18	14	12.5

I - Yashtimadhu, II - Raktachandana, III - Musta, IV - Amalaki, V - Dhanyaka, VI - Ushir, VII - Guduchi, VIII – Patol.

Three batches of MK were prepared for standardization purpose.

Observations of mass balance are mentioned in table.

Table No. 2: Mass balance of MK.

Sr. No.	Ingredients/ Batches	MK-1	MK-2	MK-3
1.	Raw Materials (g)	500	500	500
2.	Water (L)	08	08	08
3.	Total quantity obtained(L)	1.125	1.125	1.150
4.	Weight of residue after filtration (g)	900	950	930
5.	Quantity of MK taken (L)	1	1	1
6.	Quantity of sugar added $1/8^{th}$ (g)	125	125	125
7.	Quantity of honey addad $1/8^{th}$ (g)	125	125	125

Time required for preparation of MK

Observations regarding time required time required for preparation have been mentioned table.

Table No. 3: Time required for preparation of MK.

Sr. No.	Stage/Batches	MK-1	MK-2	MK-3
1.	Total time for soaking(h)	12	12	12
2.	Time taken for preparation of kwath (h)	2.40	2.50	2.40

Temperature observed during preparation of MK

Temperature observed during preparation of MK is mentioned in table.

Table No. 4: Temperature observed during preparation of MK.

Sr. No.	Stage	MK-1 0_C	MK-2 0_C	MK-3 0_C
1.	Mixing of raw material with water	35	35.2	35
2.	Mixture after keeping over night for 12 h	36.4	36.2	36.4
3.	Initiation of heating to mixture	36.8	36.6	36.6
4.	After 01 h	70.8	70.2	73.2

5.	After 02 h	84	86	85
6.	After 02 $^{1/2}$ h	88	90	88
7.	At the time of filteration	76.8	75.4	77.2
8.	After filteration	68.4	67.6	66.8

Changes of the mixture during preparation have been mentioned in table.

Table No. 5: Changes in colour during preparation of MK.

Sr. No.	Stage	MK-1	MK-2	MK-3
1.	After 1/2 h of heating to kwath	Light brown	Light brown	Light brown
2.	After 2h of heating to kwath	Brown	Brown	Brown
3.	After preparation of kwath	Brown	Brown	Brown

STANDARDIZATION OF MK

Organoleptic study of MK

After preparation of three batches of MK were subjected to organoleptic study and observations of which have been mentioned in table.

Table No. 6: organoleptic study of MK.

Sr. No.	Batches	*Shabda*	*Sparsha*	*Roopa*	*Rasa*	*Gandha*
1.	MK-1	Non significant	*Shlakshna*	Brown	*Tikta, Madhura*	*Mishragandhi*
2.	MK-2	Non significant	*Shlakshna*	Brown	*Tikta, Madhura*	*Mishragandhi*
3.	MK-3	Non significant	*Shlakshna*	Brown	*Tikta, Madhura*	*Mishragandhi*

PHYSIO-CHEMICAL ANALYSIS OF MK

After preparation of MK all three batches were subjected to Physicochemical analysis as per API guidelines and observations has been mentioned in table.

Table No. 7: Physico-chemical analysis of MK.

Parameters	Results			Mean	S.D.
	MK-1	MK-2	MK-3		
Loss on drying %	25.52	29.19	27.41	27.37	1.4984
Total Ash%	0.349	0.349	0.380	0.359	0.0141
Acid Insoluble Ash%	0.149	0.199	0.149	0.165	0.0223
Water Soluble Extract%	27.65	27.36	27.75	27.58	0.1655
Alcohol Soluble Extract%	21.60	24.63	22.80	23.01	1.2458
pH	4.38	4.36	4.30	4.34	0.0346
Sugar %	21.0	24.0	23.0	22.66	1.2472
Specific Gravity	1.10	1.16	1.10	1.12	0.0282
Density (gm/cm^3)	1.08	1.12	1.09	1.09	0.0173
Viscocity (cps)	12	12.51	13.72	12.74	0.7213

Tests for microbial plate total yeast and mold

count One batch of MK was subjected to microbial plate, yeast, and plate count for different dates to see stability of syrup.

Table No. 8: Tests for microbial plate, total yeast, and mold count.

Sr. No.	Parameters	20/02/16	21/02/16	22/02/16
1.	Total Plate Count (cfu/gm)	8.1×10^1	1.1×10^1	2.7×10^1
2.	Total Yeast & mold count (cfu/gm)	2.2 x 10	$<1 \times 10^1$	$<1 \times 10^1$

TLC analysis of MK

Rf value of all three batches of MK were mentioned in table.

Table No. 9: Rf value of TLC analysis of MK.

Bands	Rf value		
	MK-1	MK-2	MK-3
1^{st} band	0.07	0.07	0.06
2^{Nd} band	0.36	0.38	0.3
3^{rd} band	0.60	0.64	0.68
4^{th} band	0.79	0.78	0.74
5^{th} band	0.86	0.85	0.86
6^{th} band	0.96	0.92	0.98

I. B. Preparation of MKS

Three batches of MKS were prepared for standardization purpose.

Observations of mass balance are mentioned in table.

Table No. 10: Mass balance of MKS.

Sr. No.	Ingredients/ Batches	MK-1	MK-2	MK-3
1.	Raw Materials (g)	500	500	500
2.	Water (L)	08	08	08
3.	Total quantity obtained(L)	1.150	1.125	1.130
4.	Weight of residue after filtration (g)	920	950	940
5.	Quantity of MK taken (L)	1	1	1
6.	Quantity of sugar added 40% including kwath prakshep $1/8^{th}$ (g)	400	400	400
7.	Final quantity of syrup (L)	1.230	1.220	1200
8.	0.1% Sodium benzoate added(g)	1.23	1.22	1.2
9.	Quantity of syrup taken (L)	1	1	1
10.	Quantity of honey added $1/8^{th}$ (g)	125	125	125

Time required for preparation of MKS

Observations regarding time required for preparation have been in table.

Table No. 11: Time required for preparation of MKS.

Sr. No.	Stage	MKS- 1	MKS- 2	MKS- 3
1.	Total time for soaking (h)	12	12	12
2.	Time taken for preparation of kwath (h)	2.35	2.45	2.40
3.	Time taken for syrup preparation (min)	20	25	20
4.	Time taken for cooling down the syrup (min)	45	55	50

Temperature observed during preparation of MKS

Temperature observed during preparation of MKS is mentioned in table. Temperature required for kwath preparation has been shown in graph and temperature required for syrup preparation from kwath has been shown in next graph.

Table No. 12: Temperature observed during preparation of MKS.

Sr. No.	Stage	MKS-1 0_c	MKS-2 0_c	MKS-3 0_c
1.	Mixing of raw material with water	35	35.4	35.2
2.	Mixture after keeping over night for 12 h	36.6	36.4	36.8
3.	Initiation of heating to mixture	36.8	36.6	36.8
4.	After 01 h	70.6	71.5	72.2
5.	After 02 h	86	84	87
6.	After 02 $^{1/2}$ h	89	89	90
7.	At the time of filteration	76.9	75.9	77.0
8.	Initiation of heating to mixture of kwath and sugar	75.4	74.2	75.8
9.	After 20 min of heating to the mixture	95	94.5	96.3
10.	At the time of filtration of MKS	73.8	74.2	75.4
11.	Packing in sterile plastic bottles	35	35.2	35.1

Colour changes seen in the preparation of MKS

Colour changes from kwath to syrup mentioned in table.

Table No. 13: colour changes seen in preperation of MKS.

Sr. No.	Stage	MKS-1	MKS-2	MKS-3
1.	After 20 min. heating to kwath	Light brown	Light brown	Light brown
2.	After 2h of heating to kwath	Brown	Brown	Brown
3.	After preparation of kwath	Brown	Brown	Brown
4.	After preparation of MKS	Dark brown	Dark brown	Dark brown

Standardization of MKS Organoleptic testing of MKS

After preparation of three batches of MKS were subjected for organoleptic observations have been mentioned in table.

Table No. 14: Organoleptic testing of MKS.

Sr. No.	Batches	Shabda	Sparsha	Roopa	Rasa	Gandha
1.	MKS-1	Avishesh	Shlakshna	Dark brown	Madhur, Tikta	Mishragandhi
2.	MKS-2	Avishesh	Shlakshna	Dark brown	Madhur, Tikta	Mishragandhi
3.	MKS-3	Avishesh	Shlakshna	Dark brown	Madhur, Tikta	Mishragandhi

Physico chemical analysis of MKS

All three batches were subjected to physico-chemical analysis as per API guidlines and observation has been mentioned in table.

Table No. 15: Physico-chemical analysis of MKS.

Parameters	Results			Mean	S.D.
	MKS-1	MKS-2	MKS-3		
Loss on drying %	62.33	62.87	61.66	62.28	0.4949
Total Ash%	0.297	0.299	0.349	0.315	0.0223
Acid Insoluble Ash%	0.148	0.199	0.149	0.165	0.0223
Water Soluble Extract%	45.36	45.03	44.85	45.08	0.0446
Alcohol Soluble Extract%	41.79	42.72	42.60	42.37	0.1729
pH	4.30	4.43	4.30	4.34	0.0037
Sugar %	48.0	48.0	49.0	48.33	0.2222
Specific Gravity	1.222	1.229	1.212	1.221	0.0071
Density (gm/cm^3)	1.240	1.219	1.220	1.226	0.0092
Viscocity (cps)	18.94	20.12	21.80	20.29	1.1735

Tests for microbial plate total yeast and mold count

One batch of MKS was subjected to microbial plate, yeast and plate count for different dates to see stability of syrup.

Table No. 16: Tests for microbial plate, total yeast and mold count.

Sr. No.	Parameters	20/02/16	21/03/16	20/04/16
1.	Total Plate Count (cfu/gm)	5.0×10^1	0.9×10^1	$<1 \times 10^1$
2.	Total Yeast & mold count (cfu/gm)	1.8×10	$<1 \times 10^1$	$<1 \times 10^1$

TLC analysis of MKS

Rf value of all three batches of MKS were mentioned in table.

Table No. 17: Rf value of TLC analysis of MKS.

Bands	Rf value		
	MKS-1	MKS-2	MKS-3
1st band	0.07	0.07	0.07
2nd band	0.11	0.10	0.10
3rd band	0.4	0.41	0.4
4th band	0.76	0.70	0.77
5th band	0.88	0.86	0.87
6th band	0.95	0.94	0.95

II] OBSERVATION OF ANTIPYRETIC STUDY

Table No. 18: shows temperature changes in group.1(Placebo) at per hour interval for 12 hr.

Interval in hr.	Temperature of group 1 Wistar rats in ^{0}f					
	1st	2nd	3rd	4th	5th	6th
0th	96.0	96.0	97.1	96.7	95.5	96.5
1st	96.9	96.7	97.5	97.1	96.6	97.6
2nd	94.8	95.8	95.9	94.0	94.1	94.7
3rd	94.1	94.6	94.0	94.2	93.9	94.2
4th	98.1	98.3	98.7	99.9	98.5	99.5
5th	100.2	101.3	101.0	101.7	100.0	101.5
6th	101.1	101.4	101.0	101.1	101.7	101.7
7th	101.0	100.9	101.4	101.6	102.1	101.9
8th	100.8	100.7	101.0	100.5	100.5	100.7
9th	100.5	100.2	100.8	100.0	100.1	100.0
10th	99.7	99.3	99.0	98.8	99.1	98.7
11th	97.5	98.0	97.3	96.4	96.8	96.0
12th	96.2	96.5	97	96.5	95.8	96.4

Table No. 19: shows temperature changes in group.2(Standard) at per hour interval for 12 hr.

Interval in hr.	Temperature of group 2 Wistar rats in ^{0}f					
	1st	2nd	3rd	4th	5th	6th
0th	95.4	95.3	96.2	95.7	96.8	97.3
1st	96.2	96.9	97.3	96.4	97.9	97.7
2nd	94.4	94.3	95.2	95.7	94.9	95.1
3rd	94.5	94.3	94.7	95.2	95.0	95.3
4th	98.8	99.6	99.3	99.5	98.9	98.9

5 th	100.1	100.5	100.8	101.4	101.2	100.9
6 th	98.5	98.7	98.9	97.5	99.0	98.8
7 th	97.6	97.2	98.1	96.7	98.1	97.7
8 th	96.0	96.8	97.5	96.0	97.5	96.4
9 th	95.8	95.4	96.6	95.4	96.1	97.0
10 th	95.4	95.5	96.4	95.8	96.3	96.9
11 th	95.4	95.7	96.5	95.6	96.7	97.1
12th	95	95.6	95.8	95.6	96.0	97.2

Table No. 20: shows temperature changes in group.3(Test group 1 MK) at per hour interval for 12 hr.

Interval in hr.	Temperature of group 3 Wistar rats in ^{0}f					
	1 st	2 nd	3 rd	4 th	5 th	6 th
0th	96.8	98.1	97.3	95.9	96.3	96.0
1 st	96.7	97.0	97.1	96.3	96.1	96.4
2 nd	95.0	94.8	95.3	93.8	94.8	95.0
3 rd	95.1	94.3	95.2	94.8	94.9	95.0
4 th	98.9	99.3	98.8	98.5	99.7	99.9
5 th	100.2	101.0	100.1	101.1	100.8	101.8
6 th	100.3	100.0	100.5	99.9	99.7	100.2
7 th	99.3	98.8	98.7	98.0	97.0	98.9
8 th	98.7	97.9	98.1	97.3	96.5	97.3
9 th	97.4	97.5	97.7	96.4	96.0	96.7
10 th	97.0	97.7	97.5	95.7	96.5	96.3
11 th	96.9	97.5	97.0	95.4	96.0	95.9
12th	96.5	97.4	97.0	95.6	96.2	96.2

Table No. 21: shows temperature changes in group.4 (Test group 2 MKS) at per hour interval for 12 hr.

Interval in hr.	Temperature of group 4 Wistar rats in ^{0}f					
	1 st	2 nd	3 rd	4 th	5 th	6 th
0th	97.0	96.7	95.9	97.5	96.9	96.8
1 st	96.9	97.0	96.7	97.0	96.5	96.4
2 nd	95.7	96.0	95.8	95.9	95.4	95.1
3 rd	94.3	95.1	94.9	94.7	93.9	93.8
4 th	99.7	99.5	98.7	99.4	99.9	98.9
5 th	100.0	100.1	100.8	101.3	100.9	101.0
6 th	100.0	100.1	99.9	100.3	100.5	99.7

7 th	99.5	98.9	99.1	98.9	98.9	98.2
8 th	97.8	97.1	97.6	97.0	97.3	96.9
9 th	97.4	97.1	96.8	96.9	97.0	96.4
10 th	96.9	96.7	96.1	97.0	96.3	96.0
11 th	96.9	96.7	96.1	97.3	96.7	96.5
12th	96.5	96.4	95.7	97.0	96.5	96.6

Table No. 22: Shows mean temperature of all 4 groups of animals.

Interval in hr.	Group 1	Group 2	Group 3	Group 4
	Mean temperature in ^{0}f			
0th	96.3	96.1	96.7	98.1
1 st	97.0	97.0	96.6	96.7
2 nd	94.9	94.9	94.7	95.6
3 rd	95.5	94.9	94.8	94.4
4 th	98.8	99.2	99.1	99.3
5 th	100.9	100.8	100.8	100.7
6 th	101.3	98.6	100.1	100.0
7 th	101.5	97.6	98.4	98.9
8 th	100.7	96.7	97.6	97.3
9 th	100.3	96.0	96.7	96.9
10 th	99.1	96.0	96.7	96.4
11 th	97.0	96.1	96.4	96.7
12th	96.4	95.9	96.4	96.4

Table No. 23: Before and after treatment temperature after interval of 1 hr for group 1 (placebo).

No.of rats	BT (5^{th})	AT (6^{th})	AT (7^{th})	AT (8^{th})	AT (9^{th})	AT (10^{th})	AT (11^{th})	AT (12^{th})
1	100.2	101.1	101.0	100.8	100.5	99.7	97.5	96.2
2	101.3	101.4	100.9	100.7	100.2	99.3	98.0	96.5
3	101.0	101.0	101.4	101.0	100.8	99.0	97.3	97.0
4	101.7	101.1	101.6	100.5	100.0	98.8	96.4	96.5
5	100.0	101.7	102.1	100.5	100.1	99.1	96.8	95.8
6	101.5	101.7	101.9	100.7	100.0	98.7	96.0	96.4

Table No. 24: Before and after treatment temperature after interval of 1 hr for group 2 (Standard).

No. of rats	BT (5^{th})	AT (6^{th})	AT (7^{th})	AT (8^{th})	AT (9^{th})	AT (10^{th})	AT (11^{th})	AT (12^{th})
1	100.1	98.5	97.6	96.0	95.8	95.4	95.4	95.0
2	100.5	98.7	97.2	96.8	95.4	95.5	95.7	95.6

3	100.8	98.9	98.1	97.5	96.6	96.4	96.5	95.8
4	101.4	97.5	96.7	96.0	95.4	95.8	95.6	95.6
5	101.2	99.0	98.1	97.5	96.1	96.3	96.7	96.0
6	100.9	98.8	97.7	96.4	97.0	96.9	97.1	97.2

Table No. 25: before and after treatment temperature after interval of 1 hr for group 3 (MK).

No. of rats	BT (5^{th})	AT (6^{th})	AT (7^{th})	AT (8^{th})	AT (9^{th})	AT (10^{th})	AT (11^{th})	AT (12^{th})
1	100.2	100.3	99.3	98.7	97.4	97.0	96.9	96.5
2	101.0	100.0	98.8	97.9	97.5	97.7	97.5	97.4
3	100.1	100.5	98.7	98.1	97.7	97.5	97.0	97.0
4	101.1	99.9	98.0	97.3	96.4	95.7	95.4	95.6
5	100.8	99.7	97.0	96.5	96.0	96.5	96.0	96.2
6	101.8	100.2	98.9	97.3	96.7	96.3	95.9	96.2

Table No. 26: before and after treatment temperature after interval of 1 hr for group 4 (MKS).

No. of rats	BT (5^{th})	AT (6^{th})	AT (7^{th})	AT (8^{th})	AT (9^{th})	AT (10^{th})	AT (11^{th})	AT (12^{th})
1	100.0	100.0	99.5	97.2	97.4	96.9	96.9	96.5
2	100.1	100.1	98.9	97.1	97.1	96.5	96.7	96.4
3	100.8	99.9	99.1	97.6	96.8	96.0	96.1	95.7
4	101.3	100.3	98.9	97.0	96.9	97.0	97.3	97.0
5	100.9	100.5	98.9	97.3	97.0	96.3	96.7	96.5
6	101.0	99.7	98.2	96.9	96.4	96.0	96.5	96.6

Table No. 27: significance difference and SD of group 1.

Reading/hr AT	∑x	$\bar{X}$	$(x - \bar{x})$	SD	SE	t5	P value	significance
6^{th}	3.5	0.58	2.0684	0.64	0.26	2.23	<0.10	Not Significant
7^{th}	4.2	0.7	2.53	0.71	0.29	2.41	<0.10	Not Significant
8^{th}	3.7	0.62	0.7684	0.39	0.16	3.88	<0.02	Significant
9^{th}	4.9	0.82	2.4884	0.71	0.29	2.83	<0.05	Significant
10^{th}	11.1	1.85	4.7750	0.98	0.4	4.625	<0.01	Significant
11^{th}	23.7	3.95	6.8350	1.17	0.48	8.23	<0.001	Highly Significant
12^{th}	27.3	4.55	1.5150	0.55	0.22	20.68	<0.001	Highly Significant

Table No. 28: significance difference and SD of group 2.

Reading/hr AT	∑x	— X	— (x- x)	SD	SE	t5	P value	significance
6th	13.5	2.25	3.4950	0.84	0.34	6.62	<0.01	Significant
7 th	19.5	3.25	2.9950	0.77	0.31	10.48	<0.001	Highly Significant
8 th	24.7	4.12	2.8084	0.75	0.31	13.29	<0.001	Highly Significant
9 th	28.6	4.77	3.0334	0.78	0.32	14.91	<0.001	Highly Significant
10 th	28.6	4.77	1.4934	0.55	0.22	21.68	<0.001	Highly Significant
11 th	27.9	4.65	2.2150	0.67	0.27	17.22	<0.001	Highly Significant
12 th	29.7	4.95	2.3750	0.69	0.28	17.68	<0.001	Highly Significant

Table No. 29: significance difference and SD of group 3.

Reading /hr AT	∑x	— X	— (x- x)	SD	SE	t5	P value	significance
6th	4.44	0.73	3.15	0.79	0.32	2.28	<0.1	Not Significant
7 th	14.3	2.38	5.9884	1.09	0.44	5.4	<0.001	Highly Significant
8 th	19.2	3.2	7.6	1.23	0.5	6.4	<0.001	Highly Significant
9 th	23.3	3.88	6.5084	1.14	0.47	8.26	<0.001	Highly Significant
10 th	24.3	4.05	7.3750	1.21	0.49	8.27	<0.001	Highly Significant
11 th	26.3	4.38	7.8084	1.25	0.51	8.5882	<0.001	Highly Significant
12 th	26.1	4.35	5.455	1.04	0.42	10.36	<0.001	Highly Significant

Table No. 30: significance difference and SD of group 4.

Reading /hr AT	∑x	— X	— (x- x)	SD	SE	t5	P value	significance
6th	3.6	0.6	1.5	0.55	0.22	2.73	<0.05	Significant
7 th	10.6	1.77	3.3954	0.82	0.33	5.36	<0.05	Significant
8 th	20.4	3.4	2.98	0.77	0.31	10.97	<0.001	Highly Significant
9 th	22.5	3.75	3.1150	0.25	0.1	37.5	<0.001	Highly Significant
10 th	25.4	4.23	2.7325	0.74	0.3	14.1	<0.001	Highly Significant
11 th	23.9	3.98	1.9484	0.62	025	15.92	<0.001	Highly Significant
12 th	25.4	4.23	1.6334	0.57	0.23	18.39	<0.001	Highly Significant

DISCUSSION

I] Pharmaceutical and analytical study

The preparation of Madhukadi Kwatha (MK) followed the classical procedure, and batch-wise observations helped to understand its practicality in the present context. As expected, some weight loss occurred during pulverization of raw drugs into coarse powder (9–18%), which is common due to moisture evaporation and fibrous material. Even with these minor losses, the particle size was uniform, ensuring consistency during extraction.

When the decoction was prepared, yields across the three batches (1.125–1.150 L) were almost identical, which confirmed that the procedure was reproducible. Although classical references prescribe reducing to exactly one-eighth, in practice this is difficult to achieve due to evaporation rates and heating conditions. Still, the final volume remained consistent. The residue after filtration weighed slightly more than the original raw material, which can be explained by water absorption during overnight soaking.

The heating process was carefully monitored. Decoction prepared between 85–90 °C was found sufficient for extracting the active principles, without the need to reach boiling point. This also helped avoid possible destruction of heat-sensitive compounds. The gradual change in colour from light to deep brown reflected the ongoing extraction of phytochemicals, which also matched the traditional description.

The organoleptic profile of MK was uniform across batches — brown in colour, *tikta-madhura* in taste, and with a distinctive mixed aroma from ingredients like *Raktachandana, Musta, Dhanyaka* and *Ushira*. Analytical parameters further supported its quality: low total ash and acid-insoluble ash indicated purity, while higher water-soluble extractives compared to alcohol-soluble ones confirmed the predominance of water-soluble phytochemicals. The mildly acidic pH (4.3–4.4) is considered favourable for stability. Microbial testing, however, revealed that Kwatha remained stable only for 2–3 days, which is a limitation repeatedly highlighted in classical and modern texts.

To overcome these limitations, MK was converted into Madhukadi Syrup (MKS). The addition of sugar and honey not only improved palatability but also enhanced stability. Analytical findings showed clear differences: extractive values were almost doubled in MKS compared to MK, viscosity and specific gravity were higher, and sugar content was

significantly increased. These changes made the formulation denser, sweeter, and more acceptable for patients, especially children and the elderly.

Despite having higher moisture content (61–62%), MKS remained stable for at least two months. This extended shelf life was attributed to the preservative action of sugar and sodium benzoate. Microbial counts remained within safe limits, highlighting the superiority of syrup over decoction. TLC profiles of both MK and MKS showed six consistent spots across batches, which indicates that the phytochemical integrity of the formulation was preserved during conversion from Kwatha to Syrup.

Taken together, these findings show that while Madhukadi Kwatha represents the classical approach, its conversion into syrup offers practical advantages without compromising quality. The syrup form is more palatable, easier to store, and more patient-friendly, while still retaining the therapeutic essence of the original formulation.

II] Antipyretic study

The antipyretic activity was evaluated using Brewer's yeast-induced pyrexia, a well-recognized experimental model for fever studies. Pyrexia induction was confirmed 5 hours post yeast injection, with characteristic signs such as fur erection, lethargy, and decreased activity observed in all animals. After drug administration, rectal temperatures were recorded hourly for 7 hours.

In the placebo group, only a mild and delayed reduction in temperature was noted, reflecting the body's natural tendency to restore thermal balance. In contrast, the Paracetamol group demonstrated a rapid and consistent fall in rectal temperature, which was statistically highly significant ($p < 0.001$) from the first hour onward. This validated the reliability of the model.

The test groups showed promising results. Madhukadi Kwatha (MK) did not show significant effect in the first hour, but from the second hour onwards, temperature reduction was highly significant ($p < 0.001$) and sustained throughout the observation period. Madhukadi Syrup (MKS), however, produced significant reduction in temperature as early as the first two hours ($p < 0.05$), followed by highly significant results from the third hour onward ($p < 0.001$). This suggests that MKS may provide a slightly earlier onset of action compared to MK, possibly due to better solubility, stability, and faster absorption of phytoconstituents in the syrup base.

Overall, both MK and MKS showed comparable efficacy to Paracetamol, supporting their role as potential natural antipyretics.

From the Ayurvedic perspective, *Jwara* is considered the foremost among diseases, with its pathogenesis (*samprapti*) involving *mandagni*, *aama*, and *vikruta pitta*. The herbs of Madhukadi Kwatha collectively address this pathogenesis. *Laghu* and *ruksha guna* contribute to *aamapachana* and *strotovishodhana*, while *deepana* and *pachana* properties enhance *agni*. *Tikta* and *katu rasa*, along with *shita virya*, help pacify aggravated *pitta*, directly reducing fever. This holistic action, described in classical texts, resonates with the multi-target pharmacological effects observed in modern studies.

Modern research supports these traditional claims. *Yashtimadhu* exhibits anti-inflammatory, immunomodulatory, and hepatoprotective properties; *Raktachandana* is cooling and anti-inflammatory; *Musta* possesses antipyretic, antioxidant, and antimicrobial effects; *Amalaki* acts as a Rasayana with strong antioxidant and immunomodulatory activity; *Dhanyaka* improves digestion and exhibits antimicrobial activity; *Ushira* provides cooling and antioxidant effects; *Guduchi* is a well-established immunomodulator and antipyretic; and *Patola* contributes antimicrobial and hepatoprotective activity. The addition of *Madhu* and *Sharkara* not only enhances palatability but also contributes mild *jwaraghna* effects, as mentioned in classical literature.

Thus, Madhukadi Kwatha offers a multi-pronged action against fever — pacifying aggravated *pitta*, enhancing *agni*, and eliminating *aama* — while also showing pharmacological activities that align with modern antipyretic mechanisms, such as suppression of prostaglandin synthesis, antioxidant defense, and immunomodulation. Conversion into syrup form retains this therapeutic potential while addressing challenges of palatability, stability, and patient compliance.

The study therefore validates the classical claim of Madhukadi Kwatha as a *jwaraghna yoga* and demonstrates that its syrup form is not only effective and safe but also more practical for modern use. In the context of rising concerns over side effects of synthetic drugs like Paracetamol, such formulations may offer safer, well-tolerated alternatives for managing fever.

CONCLUSION

In the present dissertation titled *"Preparation, Standardization and Antipyretic Effect (in vivo) of Madhukadi Kwatha and its Syrup"*, both formulations were prepared, standardized, and evaluated for their efficacy using strict quality control (QC) and quality assurance (QA) protocols. The work was carried out in two parts—pharmaceutical standardization and experimental evaluation.

I] Pharmaceutical and Analytical Findings

Madhukadi Kwatha (MK) and its syrup (MKS) were successfully prepared following classical references. Preparation required approximately 2.5 hours for MK and an additional 20 minutes for MKS, including syrup processing. Sugar and honey were incorporated as per textual guidelines, and sodium benzoate (0.1%) was used as a safe preservative in MKS.

Standardization confirmed the quality of both formulations. MK showed total ash value of 0.36 ± 0.0141%, water soluble extractives of 27.58 ± 0.165%, alcohol soluble extractives of 23.01 ± 1.245%, pH 4.34 ± 0.0346, and viscosity 12.74 ± 0.7213. MKS displayed total ash value of 0.315 ± 0.0223%, water soluble extractives of 45.08 ± 0.0446%, alcohol soluble extractives of 42.37 ± 0.1729%, pH 4.34 ± 0.0037, and viscosity 20.29 ± 1.735. TLC studies demonstrated multiple consistent bands, indicating reproducible chemical profiles across batches. Organoleptic evaluation confirmed tikta–madhura rasa, shīta vīrya, and madhura vipāka, supporting its therapeutic role in jwara.

II] Experimental Findings

The antipyretic activity was evaluated in Wistar rats using the baker's yeast–induced pyrexia model. Both MK and MKS showed statistically highly significant reduction in rectal temperature, comparable with the standard drug paracetamol. MK at a dose of 1.44 ml/200 g body weight and its syrup form demonstrated clear efficacy in reducing pyrexia.

III] Overall Conclusion

This study confirms that Madhukadi Kwatha and its syrup are effective in lowering fever in experimental animals. The syrup form (MKS) offers added advantages of improved palatability, easier administration, and longer shelf life while retaining comparable efficacy to the kwatha.

While the results validate the classical claims of *Madhukadi Kwatha* as a potent jwaraghna yoga, it is important to note that "jwara" in Ayurveda encompasses a broader pathological entity beyond fever alone. Hence, clinical trials in larger human populations are warranted to establish its comprehensive role in jwara management.

LIMITATIONS OF THE STUDY

This study was conducted within certain limitations that should be acknowledged. Being a time-bound research project, the scope for extended experimentation and repeat trials was restricted. The available instrumental and investigatory methods for standardizing Ayurvedic formulations were limited, and not all modern analytical parameters may truly reflect the subtle changes that occur after classical pharmaceutical processing.

For the antipyretic study, only rectal temperature was used as the primary parameter, and more advanced or sophisticated methods of temperature recording could have provided greater precision. Additionally, the evaluation of *jwara* was limited to its correlation with pyrexia and antipyretic action, which does not capture the full spectrum of *jwara* as explained in Ayurveda.

SCOPE FOR FURTHER STUDY

Future research can expand upon the present findings in several ways. The efficacy of Madhukadi Kwatha may be evaluated without the addition of sugar, using suitable preservatives to extend its shelf life, which would make the formulation more suitable for diabetic patients. Detailed stability studies are also needed to better understand and improve the product's long-term preservation.

Another direction is to optimize dosage by preparing formulations from concentrated extracts of the herbs instead of decoctions, which may enhance efficacy in smaller quantities. Most importantly, clinical trials on human participants should be undertaken to validate the antipyretic activity of Madhukadi Kwatha and its syrup, thereby establishing their role as safe, effective, and patient-friendly formulations in real-world practice.

SUMMARY

This study aimed to prepare, standardize, and evaluate the antipyretic effect of Madhukadi Kwatha (MK) and its syrup form (MKS) in vivo. Classical references for MK were surveyed, and the formulation selected was based on Bhaishajyaratnavali (Jwarachikitsa). All herbal

raw materials were authenticated for species, purity, and potency, and excipients were sourced from local markets.

Pharmaceutical preparation included classical kwatha formulation and conversion into syrup, with monitoring of mass balance, temperature, and color changes. Both MK and MKS were analysed for physicochemical parameters and thin-layer chromatography (TLC) to establish standard profiles.

The in vivo experimental study was conducted following ethical approval, and statistical analysis of results was performed. Discussion highlighted factors affecting mass loss, temperature impact, sugar inversion, and physicochemical stability, and proposed standard monographs for both formulations. The probable mode of action was also described.

The study concludes that MK and MKS are standardized, pharmaceutically reproducible formulations with demonstrated preclinical efficacy, supporting their potential for further clinical evaluation.

BIBILOGRAPHY AND REFERENCES

1. Bhaishajya Ratnavali Of Kaviraj Govind Das Sen Edited With Siddhiprada Hindi Commentary by Prof. Siddhi Nandan Mishra Jwaradhikara Page No 118 Choukhamba Surbharati Prakashan, Varanasi, Reprint 2015.
2. Ayurvedic Pharmacopoeia Of India, Annexure-2 & 3 Page No. -242, 243 244, 297.
3. Protocol For Testing Of Ayurveda, Siddha, & Unani Medicine, Dept Of Ayush, Govt Of India.
4. Baghel M S A Book Entitled Research In Ayurveda Edited By Jain G K Published By Mridu Ayurvedic Publication & Sales, Jamnagar Gujarat.
5. Bharat Bhaishajyaratnakar Part 4 Shri Nagindas Chaganlal Shaha Rasavaidya makaradi kashayprakaran page no., 6-7.
6. Nighantu Adarsha Vol.I Bapalal G. Vaidya Choukhamba Bharati Academy, Varanasi, reprint 2007.
7. Dravyaguna Vidyana, Vol II, Prof. P. V. Sharma, Choukhambha Bharati Academy, Varanasi, Reprint 2006.
8. International Journal Of Pharmaceutical & Biological Activities, 2010; 1(3): 287-290.

9. Agnivesha Charak Samhita, Pratisamskarana By Charaka And Dhrudabala, Hindi Vidyotini Commentry By Pt. Kashinath Pandey And Dr Gorakhnath Chaturvedi, Choukhamba Vidya Bhavan, Varanasi, 1st Edition, 1962, Sutrasthana Chapter 1.
10. Davidson - Davidson's Principles And Practice Of Medicine 1991.
11. Krishnadas K. V. - Clinical Medicine Jaypee Brothers Medical Publishers Pvt Ltd New Delhi.
12. Sharangdhar Samhita, Prof. K.R. Shrikanta Murthy, Choukhambha Orientalia, Varanasi, Reprint- 2012 Page.
13. Shelf Life F Ayurvedic Dosage Forms- Traditional View, Currents Status And Prospective Need, Gupta, Indian Journal Of Traditional Knowladge, Oct. 2011; 10(4): Pg. No. 672-677.
14. Concise International Chemical Assessment Document 26, WHO- 2000, Benzoic Acid & Sodium Benzoate, (Www.Who.Int/Ipcs/Publications/Clcad/Clcad26_Rev_1pdf).