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NUTRITIVE COMPONENTS OF LITCHI AND ITS ANTI-DIABETIC ACTIVITY: A REVIEW

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ABSTRACT

Litchi extracts contain many components which show pharmacological activities as an anti- diabetic, anti- oxidative and increases lipolysis. The anti-diabetic property can be due to their anti-oxidant property which decreases the reactive oxygen species and also possesses α-glucosidase inhibitory property. It also has anti-inflammatory action which helps in recovery of diabetic related oral damage.

KEYWORDS: Litchi, anti-diabetic, anti-oxidation, α-glucosidase inhibitor, anti-inflammation.

INTRODUCTION

Diabetes mellitus is one of the largest global health issues which can result from inadequate insulin production or insulin resistance of peripheral tissues and augmented hepatic glucose production thereby disturbs both glucose and lipid metabolism.[1] According to International Diabetes Federation 2018 (IDF), 425 million adults have diabetes globally and 1 in 2 remains undiagnosed. IDF 2018 predicts that there will be increased in prevalence about 11% in India with diabetes by 2045.[2] Type 2 diabetes is responsible for more than 90% of all diabetes patients.[3]

The enzymes involved in glycolysis and gluconeogenesis are maily regulated by liver, thereby maintaining the normal blood glucose level in our body. In type 2 Diabetic mellitus, there is an increased in gluconeogenesis thus elevating glucose production and overall glucose uptake into muscle is reduced thereby causing hyperglycemia and other related complications.[4]

Lychee (Litchi chinensis) is an evergreen fruit tree.[5] Lychee is of the Sapindaceae family which includes L. chinensis ssp. chinensis, L. chinensis ssp. philippinensis Leenh, and L. chinensis ssp. javensis Leenh. Among these subspecies, mainly L. chinensis ssp. chinensis is prefered for cultivation.[5,6] Litchi is mainly cultivated in many countries of Southeast Asia, the Indian subcontinent, South Africa and in other tropical or sub-tropical areas around the world.[5]

Its seed, fruit and peel extracts are used as a herbal medicine for pain, gastrointestinal disease and others since ancient times in some part of the world.[5]

Many studies have shown that litchi has many pharmacological activity including antioxidant, cancer preventive, antimicrobial, anti-inflammatory activities, anti- diabetic and so on.[3]

Nutrition components of litchi

Litchi fruit contains carbohydrates like glucose, fructose, and sucrose as free sugars along with arabinose, galactose, xylose, and a trace of rhaminose. Succinic acid and malic acid are found during the fruit development phases but at maturity higher malic acid with no or very minute amount of succinic acid. Besides these, the other organic acids which are found in litchi fruit are citric, levulinic, glutaric, malonic and lactic acids. The citric acid level may found to be slightly increased during full maturity.[4]

Litchi fruit is a good source of potassium (K) and nitrogen (N) along with other minerals such as phosphorus (P), calcium (Ca), magnesium (Mg), sodium (Na) and iron (Fe). The pericarp of the lychee fruit, is a good source of phenolics, including procyanidins, anthocyanins, gallocatechin, epigallocatechin, chlorogenic acid, rutin, etc.[4]

The major amino acids identified in litchi are methionine and tryptophane and minor amount of glutamic acid, serine, alanine, threonine, tyrosine, leucine, isoleucine, lysine, and aspartic acid.

In lychee skin, the anthocyanins have been found in the form of cyanidin 3,5-diglucoside, cyanidin 3-glucoside, cyaniding 3-rutinoside, cyanidin 3-galactoside, pelargonidin 3,7-diglucoside, and malvidin 3-acetylglucoside. Flavonols like Quercetin 3-rhamnoside, quercetin 5-glucoside, quercetin-3- rutinoside (rutin) and kaempferol were reported to be present in litchi.

The major flavonoid chemicals extracted from LFP (litchi fruit pulp) as procyanidin B2, procyanidin B4, and epicatechin. The main oligomeric procyanidins isolated from LFP were epicatechin, procyanidin A2, and A-type procyanidin trimer. Procyanidins are also known as condensed tannins, and their main constitutive units are (+)-catechin, (−)epicatechin, (+)-gallocatechin and (−)-epigallocatechin 3 gallate.[4]

Oligonol, a polyphenolic product containing catechin-type monomers and lower oligomers of proanthocyanidin, is found to be present in litchi fruit.[7]

Using combine technique of gas chromatography–mass spectrometry (GC–MS), litchi was found to have 48 different volatile constituents. The citrus flavor of the fruit is mainly due to the presence of limonene, geraniol, and neral.[6]

Anti-diabetic activity of litchi

Litchi products have been reported to possess antioxidant activity, lipolysis, anti-diabetic effects, anti-inflammatory and α-glucosidase inhibitory effects and were clinically used as a traditional medicine.[7,8]

In a study conducted by Shuli Man, et al, it was found that litchi seed extract improves the quality of life of streptozotocin /high fat diet induced diabetic rats. The extract when given orally decreases pancreas, liver and kidney damage besides decreasing blood glucose level without causing hypoglycaemia.[1]

Hyperglycaemia causes glucose overload in the kidney tissues, which can be associated with mitochondrial dysfunction thereby causing renal damage.Litchi seed extract increases glucose and lipid metabolism and decreased the oxidative stress, thus it induces recovery from renal injury.[1]

Even more, atherogenic dyslipidaemia was seen in diabetic rats. In the study they found litchi seed extract significantly reduced mRNA expression of diglyceride acyltransferase (DGAT2) which catalyses the formation of triglyceride and fatty acid synthase (FAS). Hence, the extract decreases the LDL level and increases HDL-C/LDL-C ratio.[1]

In another study conducted by REN Shen, et. al, a new flavanone glycoside, (2S)-pinocember-7-O-(6’’-O-α-L-arabinosyl-β-D-gluco-pyranoside) was obtained from litchi

seeds. It was found to have α-glucosidase inhibitory activity thereby decreasing glucose absorption.[7]

1. Procyanidin

In litchi, Catechin-rich procyanidin compounds have antioxidant property and many other therapeutic uses in the management of obesity and hyperglycemia in type 2 diabetes mellitus patients. In some studies epigallocatechin gallate was found to have beneficial effects on blood sugar level by decreasing reactive oxygen species thereby decreases the oxidative stress and reducing the expression of proinflammatory cytokines which in turn prevent the complications of diabetes.[1,6,7]

2. Flavanoids

Flavanoids can act as insulin secretagogues or insulin mimetics by influencing pleiotropic mechanism i.e. inhibition of dipeptidyl peptidase.[9] (2S)-pinocember-7-O-(6''-O-α-L-arabinosyl-β-D-gluco-pyranoside) has direct α-glucosidase inhibitory activity. It inhibits α-glucosidase which catalyse the breakdown of saccharides into glucose thus showing its anti-diabetic property.[7,10,11]

3. Oligonol

Oligonol is a polyphenolic extract. It has been shown to have powerful antioxidant activity and causes significantly increase in lipolysis and improve diabetic related organ injuries.[3,7] It increases serum and pancreatic insulin and C-peptide levels. It was also found to decrease the enhanced levels of reactive oxygen species and 2-thiobarbituric acid reactive substances which are oxidative stress biomarkers. It also decreases the overexpression of phospho- p 38, phosphor ERK1/2, phosphor-inhibitor of nuclear factor kappa B (NF-kB), NF-kBp65 and NF-kBp65 induced inflammatory proteins like COX-2, NO synthase, TNF-α and IL-6. Thus it decreases pancreas damage and due to their anti-oxidative stress related anti-inflammatory action, it is regarded to have anti- diabetic activity.[12,3,8]

4. Hypoglycin-A

Hypoglycin or A, β-(methylenecyclopropyl) alanine is an amino acid found in a variety of fruits including litchi especially the unripe fruits.[13] It has the property to cause severe hypoglycemia. In some of the studies, it was found that hypoglycin A inhibits and interfere Krebs cycle.

Gluconeogenesis process utilizes many amino acids mainly alanine (Ala), valine (Val), leucine (Leu) and glycine (Gly) as a component of catalyzed enzymes like glucose-6-phosphatase, glucose-6-phosphate isomerase and triosephosphate isomerase.[13]

Hypoglycin-A can interact with valine and leucine molecular electronically. Hence, it can inhibit the enzyme containing the above amino acids, causing interference in gluconeogenesis and decreases glucose production. Therefore glycolysis rate decreased and pyruvate synthesis and the next step involving in kreb's cycle are abruptly affected. It can lead to lactic acidosis which is a serious toxic side effect of hypoglycin-A.[13]

CONCLUSION

Litchi fruit contains a variety of nutrients which have a variety of pharmacological activities including anti-oxidant, anti-hyperlipidemic, anti-tumor, anti-diabetic, etc. The extract of litchi fruit shows its anti-diabetic property which can be due to the presence of catechin, flavones, oligonol, etc. These components decreases the blood glucose level as well as prevent and cure diabetic related organ injury. But the presence of Hypoglycin –A shows severe hypoglycemic effect which can be more dangerous rather than anti-diabetic effect. So, Hypoglycin-A should be separated from the extract before using as an extract for anti-diabetic activity.

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