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NUTRITIONAL AND HEALTH BENEFITS OF MULBERRY (*MORUS NIGRA* L.)Shivangi Sharma<sup>1\*</sup> and Gita Bisla<sup>2</sup>\*Corresponding Author: **Shivangi Sharma**, ✉ shivangineha91@gmail.comReceived on: 26<sup>th</sup> October 2018Accepted on: 15<sup>th</sup> November, 2018

Black mulberry (*Morus nigra* L.) is a fruit which recognized for their attractive color and flavor. It is also use in natural remedy because of their high content of nutritional qualities and active healing compounds since Mulberry is used in a balanced diet. The fruit is used in a fresh or processed form. Mulberry fruit was also beneficial for many diseases like hepatoprotective activity, diabetes, cardiovascular disease, obesity and many more.

**Keywords:** Bioactive compounds, Anthocyanins, Antioxidants, Hyperlipidemia

**INTRODUCTION**

The fruit mulberry is related to *Morus* group and the family Moraceae and its consisting more than 20 species. Mostly the species are: the white mulberry (*Morus alba*), black mulberry (*Morus nigra*) and red mulberry (*Morus rubra*) (Krishna *et al.*, 2015). The black mulberry (*Morus nigra* L.) fruit is not recognized for their good taste and nutritive values except for their traditional uses in natural remedy because of their high content of active healing compounds (Kamiloglu *et al.*, 2013). The mulberry fruit colors vary as of white to pinkish white, purple or dark purple to black. It is juicy and unique delicious soft fruit with sweet flavor and a little bitterness which gives refreshing taste (Ruzica *et al.*, 2013). Because of their sweetness the fruit can be consumed both as fresh and processed form like preparation of wine, syrup, pulp, ice cream, vinegar, alcohol, jam or soft drinks (Kamiloglu *et al.*, 2013). Mulberry is also used in some medicines in the form of conventional herbs due to their chemical composition and pharmacological function (Bajpai *et al.*, 2012).

**SCIENTIFIC CLASSIFICATION**

- Kingdom: Plantae
- Order: Rosales
- Family: Moraceae
- Tribe: Moreae
- Genus: *Morus*
- Botnical Name: *Morus Nigra* Linn
- English Name: Black Mulberry
- Hindi Name: Shahtoot

**NUTRITIONAL AND PHYTOCHEMICAL COMPOSITION**

Mulberry have some essential bioactive compounds like sugars (glucose and fructose), minerals, vitamins, fats (mostly linoleic acid, palmitic acid, and oleic acid) and phenolic compounds, alkaloids, flavonoids, tannins, carotenoids (Niratker *et al.*, 2015). Mulberries have those kinds of fatty acids which the human body cannot produce.

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Black mulberry contains bioflavonoid a natural antioxidants and also contains non anthocyanin phenolics (Volkan *et al.*, 2016). Mulberry fruits contains 85-88% of water, 7.8-9.2% carbohydrate (sugars, mainly glucose and fructose), 0.4-1.5% protein, 0.4-0.5% fat, 1.1-1.9% free acids (mainly malic acid), 0.9-1.4% fiber and 0.7-0.9% minerals. It contains calcium 60 mg/100 g, phosphorus 20 mg/100 g, iron 2.6 mg/100 g, thiamine 58 mg/100 g, nicotinic acid 0.2 mg/100 g, riboflavin 92 mg/100 g, Vitamin C is 20 mg/100 g in fresh fruit (Savithri and Sujathamma, 2016). Mulberries extract yield 6.9-54.0% total phenolics and 201-2287 mg/100 g total flavonoids (Mahmood *et al.*, 2012). In its extract gallic acid 0.31%, protocatechuic acid 2.92%, catechin 0.54%, epigallocatechingallate 2.68%, caffeic acid 1.10%, epicatechin 1.21%, *p*-coumaric acid 0.35%, rutin 3.22%, ferulic acid 0.27%, gossypin 0.26%, hesperetin 0.34%, resveratrol 0.35%, quercetin 0.50%, naringenin 0.52%, and hydroxyflavin 0.58% are also present (Pawlowska *et al.*, 2008).

## HEALTH BENEFITS

Berries are the vital sources of health benefits compounds. In mulberry presence of phenolics compounds helps to prevent the hypolipidemic effects as well as macrophage activating. Mulberry has their antioxidant capacity which helps to reduce the risk factors for sever diseases like strokes, cancer and cardiovascular disease (Butt *et al.*, 2008). Mulberry are used to keep the body safe for various common diseases like diarrhea, constipation, nausea, intestinal worms, sinusitis, throat soreness, urinary tract infections, diabetes, fever, asthma, kidney disorders, cataracts, cyto and hepatoprotectivity, vaginal discharge or menstrual problems, depression, migraines and to control oxidative stress which helps to reduce the signs of aging. Mulberry also is capable to nourish and help to production of body fluid (Naowaboot *et al.*, 2009).

## Hepatoprotective Activity

Mulberry have flavonoids, coumarine and stilbene which holds hepatoprotective action (Oh *et al.*, 2002). Fruit contains protective action against peroxidative damage. The complex is effective antioxidant with liver protective action against CCl<sub>4</sub>-induced hepatotoxicity (Jin *et al.*, 2005). Hepatocellular carcinoma (HCC) is the mainly ordinary liver cancer for 90% of main liver cancers. The common issue for HCC is Liver Cirrhosis (LC) resulting from virus infection, alcohol consumption, nonalcoholic fatty liver disease (NAFLD) and some hereditary diseases. An epidemiological

fact suggests that the regular uses of fruits and vegetables in our diet can decrease the lots of diseases (El-Serag and Rudolph, 2007).

## Vasoactive and Neuroprotective Action

Vasoactive property results also rising or falling blood pressure. The mulberry fruit have capacity to prevent the neuronal cell injure because of cyanidin-3-O- $\beta$ -D-glucopyranoside. Mulberry have neuroprotective properties and prevent the cerebral ischemic damage caused by Oxygen Glucose Deprivation (OGD) (Nakamura *et al.*, 2009). The mulberry fruit having protective property against neurotoxicity in vitro and in vivo Parkinson's disease. Mulberry fruit considerably protected the cells from neurotoxicity in a dose dependent manner (Kim *et al.*, 2010). Mulberry extract contains valuable effects of its phenolics and anthocyanins compounds (Zhang *et al.*, 2008). Free radicals production is generally cause for the neurodegeneration. The uses of mulberry helps to prevent some common neurodegeneration disorder like alzheimer's disease and Parkinson disease (Niidome *et al.*, 2007). Mulberry isolated compounds are able to be used as neuroprotective agents for neurodegenerative diseases treatment (Tian *et al.*, 2005).

## Anti-Inflammatory Activity

Anti-inflammatory normally used for the property of reduces swelling. The uses of anti-inflammatory herbs for health enhancement have a long and successful history in traditional medicine. Flavonoids and other compounds were isolated from mulberry which exhibited the anti-inflammatory property (Chatterjee *et al.*, 1983).

## Antioxidants Activity

Antioxidants decrease the oxidation process and it is helpful for the physiological process. Generally we consume the food stuff in our diet the antioxidants are present in the food items either it is fruits or vegetables. The mulberry fruit have polyphenols, carotenoids and vitamins like A, C, E. These compounds help to improve the status of body's antioxidant. The fruit compounds effect the human body to prevent the different diseases like cancer, heart disease, common illness and it is helpful for the oxidation of low density lipoprotein (Andallu *et al.*, 2009). Mulberry fruit also useful for the diabetes because mulberry reduce the harmful effect of oxidative substances in red blood cells (Hong *et al.*, 2004). The presence of some phytochemicals (phenolic acids and flavonols) are plays the role of functional

fruit and due to the prevention of various diseases which is related with oxidative stress are consideration to give the health effects of fruit-derived products (Lodovici *et al.*, 2001). Many studies shows mulberry contains some biological activities which is effected some diseases such as antiallergic, antiviral, antitumor and antiinflammatory action (Harborne and Williams, 1992). Black mulberry contains some components with antioxidant activity which inhibited the human cytochrome action in the pooled human liver microsome system (Kim *et al.*, 2006). It is the imbalance between pro-oxidants and antioxidant mechanisms. This results in an extreme oxidation metabolism. The oxidative stress can due to some environmental factors like contact to pollutants, alcohol, medicine, illness, poor diet, toxins and radiations and so on. Oxidative damage to DNA protein and other macromolecules may direct to a wide range of human diseases mostly heart disease or cancer (Jaruchotikamol and Pannangetch, 2013).

### Hyperlipidemic Action

Hyperlipidemia is characterizing by excess cholesterol and fatty substances in the blood. Hyperlipidemia is a risk issue for heart disease. Diabetes mellitus is also connected with different kinds of lipid peculiarity. Cholesterol particularly LDL (Low-Density Lipoprotein) and VLDL (Very-Low-Density Lipoprotein) cholesterol are occupied in the development of atherosclerosis (Andallu *et al.*, 2009). Mulberry is found that when it is compared with glibenclamide treatment it is able to against lipid peroxidation (Andallu *et al.*, 2001). Mulberry contains various components which showed that hypoglycemic functions have defensive consequences on pancreatic  $\beta$  cells, block their degeneration and decreased lipid peroxidation (Singab *et al.*, 2005).

### Anti Obesity Action and Cardiovascular Function

Obesity is distinct as abnormal or wasteful fat accumulation to present in our body. Overweight people have accumulated so much body fat that has a harmful effect on their health. Obesity is connected with the diabetes, hypercholesterolemia, hyperlipidemia, hepatic steatosis, metabolic syndrome, cardiovascular disease, atherosclerosis and reduce the amount of sugars absorbed has consequences for body weight (Bajpai *et al.*, 2012). There is a metabolic basis connecting with the expanded abdominal fat store to high TG, low HDL, high LDL dyslipidemia, and insulin resistance, which are often

accompanied with impaired metabolic regulation in adipose tissue leading to an overproduction of Free Fatty Acid (FFA) (Despres, 2006).

Diseases of the cardiovascular system are with the diseases of civilization and the main cause for the death. The major cause of them is measured poor nutrition, hypertension, low physical activity, high cholesterol, extreme alcohol use and metabolic syndrome that are related with obesity and stress. The use of mulberry water infusions to treat high blood pressure, decrease cholesterol and defend against atherosclerosis (Priya, 2012). Anthocyanins are able to decrease cardiovascular risk, get better inflammation, helpful for chemical toxicity and cerebral ischemic harm (Kang *et al.*, 2006). Anthocyanins of mulberry fruit can scavenge free radicals, reduce LDL oxidation and maintain the blood lipid and atherosclerosis (Du *et al.*, 2008). Treatment of the freeze-dried powder of mulberry contain a high-fat diet resulted in an important decline in the levels of serum and liver TG, TC, serum LDL, while the serum HDL much increased (Yang *et al.*, 2010).

### Hypoglycemic Activity

Hypoglycemia is a state when the blood sugar level is too low in body. Diabetes mellitus is cause by the insulin produced by pancreas. the concentration level of glucose increase in the blood which harm many body systems in specially blood vessels and nerves Due to lack of insulin secreted by pancreas (Bajpai *et al.*, 2012). Mulberries used in the treatment of diabetes because it is having the properties of hypoglycemic. Mulberry plays the important role in the hypoglycemic action since it contains moranolin (DNJ), Moran (glycopeptides), hydrophobic flavonoids (flavones and flavonone) and 2-arylbenzofuran (Singab *et al.*, 2005).

### Anticancer Effects

Cancer is one of the main causes of deaths. (Naderi *et al.*, 2004). Due to the use of polyphenol rich diets in our daily life the occurrence of cancer is automatically low (Yang *et al.*, 2001). So a regular analysis the mulberry contains chemopreventive potential which improve anticancer properties (Cui *et al.*, 2010). The dietary polyphenols present in mulberry plays the protective role against the different types of cancers (Singh *et al.*, 2010). The chemopreventive efficacy of mulberry is to capable for the interruption of the carcinogenesis process which effects the inteacellular signaling network molecules (Manson, 2003).

## Antidiabetes

The fruit mulberry contains the capacity to improve the diabetes (Ha *et al.*, 2012). Mulberries have been used in Chinese medicine for the avoidance and management of diabetes because it contains chemical compounds that suppress the high blood sugar levels (hyperglycemia) (Miyahara *et al.*, 2004). In our human body the blood sugar or glucose level is controlled which is most important. When they consume high glycemic index food stuff like potatoes or some sweets the body react of these kind of food stuff. The body wants to deal with overload iteams, body produce the extra insulin to deal with such kind of stuffs. So in this situation the pancreas is impaired and it is not make the sufficient insulin. Our cells may become resistant to insulin as it tries to do its job of facilitating glucose transport during the cell walls. At end of the result is the insulin resistance is in unsafe situation. Generally the diabetes depend on the person is obese or not. When the person is obese the risk for diabetes is high but the other way the person is not obese the risk factor of diabetes is low (Andallu *et al.*, 2001). So when the patient is suffering from diabetes mellitus the Mulberry fruit suggest consuming in their diet because it is having the property of 1-deoxynojirimycin (DNJ) and alpha-glucosidase which inhibitors the diabetes mellitus (Asai *et al.*, 2011).

## Hypolipidemic Activities

Morus have its healing properties and usually used for hypolipidemic activities (Ahmad *et al.*, 2013). Consumption of Mulberry root barks (70% alcohol extract) can work as a powerful hypocholesterolemic nutrient and also inhibition of LDL antherogenic modifications and lipid peroxidase formation in hypocholesterolemic subjects (El *et al.*, 2006). Moracin present in mulberry leaves are able to inhibiting lipid peroxidation (Sharma *et al.*, 2001).

## Other Diseases

Mulberry contains nutritious elements such as minerals and vitamins which improve the severe diseases related to the digestive tract, promote gastric juice secretion, strengthen the ability for digesting and assimilating (Shih *et al.*, 2009). Mulberry is helpful for the chronic gastritis, hepatitis, Alzheimer diseases, constipation and it is improve the hunger ability (Ha *et al.*, 2012).

## CONCLUSION

Mulberry is one of the important herbs and the properties of pharmacological which are used in medicine recently in

many countries. Mulberry fruit has beneficial effects of lots of diseases because of good source of bioactive substances, phenolic compounds and antioxidant capacity that protect the human body against diseases of civilization. Its action is versatile and bioactive substances are arranged in different parts of the plant showed antimicrobial potential and free radical scavenging activity. Mulberry fruit is helping to improve in protecting liver, improving eyesight, facilitating discharge of urine, lowering of blood pressure, anti-diabetic, weight controlling in human being. It is useful for neurodegenerative disorders (Alzheimer and Parkinson) and contains immune-modulation and chemo-protective properties.

## REFERENCES

- Andallu B, Suryakantham V, Lakshmi B and Reddy G K (2001), "Effect of Mulberry (*Morus indica* L.) Therapy on Plasma and Erythrocyte Membrane Lipids in Patients with Type 2 Diabetes", *Clinical Chemical Acta*, Vol. 314, pp. 47-53.
- Andallu B, Vinay Kumar A V and Varadacharyulu N (2009), "Lipid Abnormalities in Streptozotocin-Diabetes: Amelioration by *Morusindica* L. cvSuguna Leaves", *International Journal of Diabetes DevCtries*, Vol. 29, No. 3, pp. 123-128.
- Ahmad A, Gupta G, Afzal M, Kazmi I and Anwar F (2013), "Antiulcer and Antioxidant Activities of a New Steroid from *Morus Alba*", *Life Sciences*, Vol. 92, No. 3, pp. 202-210.
- Asai A, Nakagawa K, Higuchi O, Kimura T, Kojima Y, Kariya J, Miyazawa T and Oikawa S (2011), "Effect of Mulberry Leaf Extract with Enriched 1-deoxynojirimycin Content on Postprandial Glycemic Control in Subjects with Impaired Glucose Metabolism", *J Diabetes Investigation*, Vol. 2, No. 4, pp. 318-323.
- Bajpai S, Rao A V B, Muthukumaran M and Nagalakshamma K (2012), "History and Active Pharmacokinetic Principles of Mulberry: A Review", *Journal of Pharmacy*, Vol. 2, No. 4, pp. 13-16.
- Butt M S, Nazir A, Sultan M T and Schroen K (2008), "Morus Alba L. Natures Functional Tonic", *Trends Food Science Technology*, Vol. 19, pp. 505-512.
- Chai O H, Lee M S, Han E H, Kim H T and Song C H (2005), "Inhibitory Effects of *Morus Alba* on Compound 48/80-Induced Anaphylactic Reactions and Anti-

- chicken Gamma Globulin IgE-mediated Mast Cell Activation”, *Biological Pharmacy Bull*, Vol. 28, No. 10, pp. 1852-1858.
- Chatterjee G K, Burman T K, Nagchaudhuri A K and Pal S P (1983), “Antiinflammatory and Antipyretic Activities of *Morusindica*”, *Plantate Medical*, Vol. 48, No. 2, pp. 116-119.
  - Cui X, Jin Y, Hofseth A B, Pena E, Habiger J, Chumanevich A *et al.* (2010), “Resveratrol Suppresses Colitis and Colon Cancer Associated with Colitis”, *Cancer Prevention Res (Phila)*, Vol. 3, pp. 549-559.
  - Despres J P (2006), “Is Visceral Obesity the Cause of the Metabolic Syndrome?”, *Annual Medicine*, Vol. 38, pp. 52-63.
  - Du Q, Zheng J and Xu Y (2008), “Composition of Anthocyanins in Mulberry and their Antioxidant Activity”, *J Food Compos Anal.*, Vol. 21, pp. 390-395.
  - El-Serag H B and Rudolph K L (2007), “Hepatocellular Carcinoma: Epidemiology and Molecular Carcinogenesis”, *Gastroenterology*, Vol. 132, pp. 2557-2576.
  - El-Beshbishy HA, Singab A N B, Sinkkonen J and Pihlaja K (2006), “Hypolipidemic and Antioxidant Effects of *Morus alba* L. (*Egyptian Mulberry*) Root Bark Fractions Supplementation in Cholesterol-Fed Rats”, *Life Sciences*, Vol. 78, pp. 2724-2733.
  - Ha U S, Koh J S, Kim H S, Woo J C, Kim S J, Jang H, Yoon B I, Hwang S Y and Kim S W (2012), “Cyanidin-3-O-D-glucopyranoside Concentrated Materials from Mulberry Fruit have a Potency to Protect Erectile Function by Minimizing Oxidative Stress in a Rat Model of Diabetic Erectile Dysfunction”, *American Journal of Chinese Medecine*, Vol. 40, No. 2, pp. 349-356.
  - Ha U S, Koh J S, Kim H S, Woo J C, Kim S J, Jang H *et al.* (2012), “Cyanidin-3-O-Beta-D-glucopyranoside Concentrated Materials from Mulberry Fruit have a Potency to Protect Erectile Function by Minimizing Oxidative Stress in a Rat Model of Diabetic Erectile Dysfunction”, *Urology International*, Vol. 88, pp. 470-476.
  - Harborne J B and Williams C A (2000), “Advances in Flavonoid Research Since 1992”, *Phytochemistry*, Vol. 55, pp. 481-504.
  - Hamzaa R G, Shahat A N E and Mekawey H M S (2012), “The Antioxidant Role of Mulberry Fruits in Ameliorating the Oxidative Stress Induced in  $\gamma$ -Irradiated Male Rats”, *Biochemistry & Analytical Biochemistry*, Vol. 1, No. 8, pp. 3-6.
  - Hong J H, Ahn J M, Park S W and Rhee S J (2004), “The Effects of Mulberry Fruit on the Antioxidative Defense Systems and Oxidative Stress in the Erythrocytes of Streptozotocin-Induced Diabetic Rats”, *Nutrition Science*, Vol. 7, pp. 127-132.
  - Jaruchotikamol A and Pannangpetch P (2013), “Cytoprotective Activity of Mulberry Leaf Extract Against Oxidative Stress-Induced Cellular Injury in Rats”, *Pakistan Journal Pharmacy Science*, Vol. 26, No. 1, pp. 163-168.
  - Jin Y S, Sa J H, Shim T H, Rhee H I and Wang M H (2005), “Hepatoprotective and Antioxidant Effects of *Morus Bombycis* Koidzumi on CCl<sub>4</sub>-induced Liver Damage”, *Biochemistry Biophysics Res Community*, Vol. 329, No. 3, pp. 991-995.
  - Kamiloglu S, Serali O, Unal N and Capanoglu E (2013), “Antioxidant Activity and Polyphenol Composition of Black Mulberry Products”, *Journal of Berry Research*, Vol. 3, pp. 41-51.
  - Kang T H, Hur J Y, Kim H B, Ryu J H and Kim S Y (2006), “Neuroprotective Effects of the Cyanidin-3-O-Beta-d-glucopyranoside Isolated from Mulberry Fruit Against Cerebral Ischemia”, *Neurosci Lett.*, Vol. 391, pp. 122-126.
  - Kim H G, Ju M S, Shim J S, Kim M C, Lee S H, Huh Y, Kim S Y and Oh M S (2010), “Mulberry Fruit Protects Dopaminergic Neurons in Toxin-Induced Parkinsons Disease Models”, *British Journal of Nutrition*, Vol. 104, pp. 8-16.
  - Krishna V, Sujathamma P, Savithri G and Vijaya T (2015), “Mulberry: The Fruit of Heavens Choice”, *Hortflora Research Spectrum*, Vol. 4, No. 1, pp. 82-85.
  - Kim H, Yoon Y J, Shon J H, Cha I J, Shin J G and Liu K H (2006), “Inhibitory Effects of Fruit Juices on CYP3A Activity”, *Drug Metabolism Disposable*, Vol. 34, pp. 521-523.
  - Lodovici M, Guglielmi F, Meoni M and Dolara P (2001), “Effect of Natural Phenolic Acids on DNA Oxidation *in vitro*”, *Food Chemistry Toxicology*, Vol. 39, pp. 1205-1210.

- Manson M M (2003), “Cancer Prevention - The Potential for Diet to Modulate Molecular Signalling”, *Trends Molecular Medecine*, Vol. 9, pp. 11-18.
- Mahmood T, Anwar F, Abbas M and Saari N (2012), “Effect of Maturity on Phenolics (Phenolic Acids and Flavonoids) Profile of Strawberry Cultivars and Mulberry Species from Pakistan”, *International Journal of Molecular Science*, Vol. 13, pp. 4591-4607.
- Miyahara C, Miyazawa M, Satoh S, Sakai A and Mizusaki S (2004), “Inhibitory Effects of Mulberry Leaf Extract on Postprandial Hyperglycemia in Normal Rats”, *Journal Nutrition Science Vitaminology*, Vol. 50, pp. 161-164.
- Naowaboot J, Pannangpetch P, Kukongviriyapan V, Kongyingyoes B and Kukongviriyapan U (2009), “Antihyperglycemic, Antioxidant and Antiglycation Activities of Mulberry Leaf Extract in Streptozotocin-Induced Chronic Diabetic Rats”, *Plant Foods Human Nutrition*, Vol. 64, No. 2, pp. 116-121.
- Nakamura M, Nakamura S and Oku T (2009), “Suppressive Response of Confections Containing the Extractive from Leaves of *Morus Alba* on Postprandial Blood Glucose and Insulin in Healthy Human Subjects”, *Nutrition Metabolism (Lond)*, Vol. 6, p. 29.
- Niratker C R and Preeti Malti (2015), “Antimicrobial Activity of Leaf Extract of *Morus Indica* from Chhattisgarh”, *Asian Journal of Plant Science and Research*, Vol. 5, No. 1, pp. 28-31.
- Niidome T, Takahashi K, Goto Y, Goh S M, Tanaka N and Kamei K (2007), “Mulberry Leaf Extract Prevents Amyloid Beta-Peptide Fibril Formation and Neurotoxicity”, *Neuroreport*, Vol. 18, pp. 813-816.
- Oh H, Ko E K, Jun J Y, Oh M H, Park S U and Kang K H (2002), “Hepatoprotective and Free Radical Scavenging Activities of Prenylflavonoids, Coumarin and Stilbene from *Morus Alba*”, *Plantal Medecin*, Vol. 68, No. 10, pp. 932-934.
- Pawlowska A M, Oleszek W and Braca A (2008), “Qualitative Analyses of Flavonoids of *Morus nigra* L. and *Morus alba* L. (*Moraceae*) Fruits”, *Journal Agriculture of Food Chemistry*, Vol. 56, pp. 3377-3380.
- Priya S (2012), “Medical Values of Mulberry—An Overview”, *Journal of Pharmaceutical Research*, Vol. 5, pp. 3588-3596.
- Ruzica J M, Danica S D, Danijela A K, Gordana S S, Snezana S M, Milan N M, Aleksandra N P and Sasa S R (2013), “Content of Heavy Metals in Mulberry Fruits and their Extracts Correlation Analysis”, *American Journal of Analytical Chemistry*, Vol. 4, pp. 674-682.
- Savithri G and Sujathamma P (2016), “Mulberry and Silkworm as a Healthy Foodstuff—A Review”, *International Journal of Recent Scientific Research*, Vol. 7, No. 6, pp. 12244-12246.
- Singh U P, Singh N P, Singh B, Hofseth L J, Price R L, Nagarkatti M *et al.* (2010), “Resveratrol (Trans-3,5,4'-trihydroxystilbene) Induces Silent Mating Type Information Regulation-1 and Down-Regulates Nuclear Transcription Factor-KappaB Activation to Abrogate Dextran Sulfate Sodium-Induced Colitis”, *Journal Pharmacology Exp Thermal*, Vol. 332, pp. 829-839.
- Singab A N, El-Beshbishy H A, Yonekawa M, Nomura T and Fukai T (2005), “Hypoglycemic Effect of Egyptian *Morus Alba* Root Bark Extract: Effect on Diabetes and Lipid Peroxidation of Streptozotocin-Induced Diabetic Rats”, *Journal of Ethnopharmacology*, Vol. 100, No. 3, pp. 333-338.
- Sharma R, Sharma A, Shono T, Takasugi M, Shirata A, Fujimora T and Machii H (2001), “Mulberry Moracins: Scavengers of UV-Stress Generated Free Radicals”, *Bioscience Biotechnology Biochemistr*, Vol. 65, No. 6, pp. 1402-1405.
- Shih P H, Chan Y C, Liao J W, Wang M F and Yen G C (2009), “Antioxidant and Cognitive Promotion Effects of Anthocyanin-Rich Mulberry (*Morus atropurpurea*) on Senescence Accelerated Mice and Prevention of Alzheimers Disease”, *Plant Foods Hum Nutrition*, Vol. 64, No. 2, pp. 116-121.
- Tian J, Fu F, Geng M, Jiang Y, Yang J, Jiang W, Wang C and Liu K (2005), “Neuroprotective Effect of 20(S)-ginsenoside Rg3 on Cerebral Ischemia in Rats”, *Neuroscience Letter.*, Vol. 374, pp. 92-97.
- Volkan O, Mehmet P and Mehmet A A (2016), “Some Physic-Chemical Characteristics of Black Mulberry in Bitlis”, *Horticulture*, Vol. B, No. LX, pp. 27-30.
- Wang L, Yang Y, Liu C and Chen R Y (2010), “Three New Compounds from *Morus Nigra* L”, *Journal of Asian Natural Produce Res.*, Vol. 12, pp. 431-437.

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- Yang C S, Landau J M, Huang M T and Newmark H L (2001), “Inhibition of Carcinogenesis by Dietary Polyphenolic Compounds”, *Annual Review Nutrition*, Vol. 21, pp. 381-406.
  - Yang X, Yang L and Zheng H (2010), “Hypolipidemic and Antioxidant Effects of Mulberry (*Morus alba* L.) Fruit in Hyperlipidaemia Rats”, *Food Chem Toxicol*, Vol. 48, pp. 2374-2379.
  - Zhang W, Han F and Duan C (2008), “HPLC-DAD-ESI-MS/MS Analysis and Antioxidant Activities of Non-anthocyanin Phenolics in Mulberry (*Morus alba* L.)”, *Journal Food Science*, Vol. 73, No. 51, pp. 512-518.



