Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 9[10] September 2020 : 11-16

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

REVIEW ARTICLE **OPEN ACCESS**

Nutritional and Pharmaceutical Perspectives of Muskmelon : A Comprehensive Review

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ABSTRACT
Cucumis melo L. is a plant species from Cucumber i.e. Cucurbitaceae family found in western ghats of Maharashtra, Gujarat, Rajasthan and Punjab region of India. In this review, nutritional and pharmaceutical perspectives of Muskmelon are emphasized. The terminology Muskmelon originated from Latin and Persian words Musk which means perfume and melon means Apple shaped fruit. In Roman culture, fruit powder of Muskmelon was used for sprinkling on the food for its flavor. Muskmelon fruits are rich sources of Vitamins, Minerals and Nutrients which significantly indicates high potential of this plant for its use as medicine for various diseases.

Keywords
Cucumis melo L., Pharmaceuticals, Nutritional aspects, Vitamins, Minerals

Received 22.05.2020 Revised 29.07.2020 Accepted 13.08.2020

INTRODUCTION

Muskmelon (*Cucumis melo L.*) is a vining plant belonging to the Cucurbitaceae family. This warm-season crop is sensitive to cold temperatures and requires a fairly long growing season from seed to marketable fruit. Muskmelon is a beautiful, juicy, tasty and delicious fruit popular for its nutritive and medicinal properties. Musk melon is recommended for the treatment of cardiovascular disorders, as a diuretic, stomachic, antitussive and as a vermifuge. Its seeds are used to treat tuberculosis. They have high levels of potassium. Muskmelons are considered diuretics due to their high water content. It has been researched that Muskmelons possess the ability to lower the risk of cancer. Muskmelon (*Cucumis melo* L) is a representative of cucumber (Cucurbitaceous) family. Muskmelon is also known as "Nut meg" melons. The name is derived from the Romans habit of sprinkling the fruit with powdered musk to accentuate the flavor. The word 'Musk' is derived from Persian literature which means "Perfume" and other word "melon" is fresh from the Latin Melope meaning "apple-shaped melon". [1,6]
The initial instances of its cultivation have been founded to date back to 2000 B.C. In fact the fruit is said to have originated in ancient Persia and Africa.

SCIENTIFIC CLASSIFICATION

Table 1. Scientific Classification of *Cucumis melo L.* (Muskmelon Fruits) [6]

Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Rosids
Order:	Cucurbitales
Family:	Cucurbitaceae
Genus:	*Cucumis*
Species:	*C. melo*

CULTIVATION, COLLECTION AND PROCESSING OF MUSKMELON

Muskmelon (*Cucumis melo L.*) is a species of melon that has been developed into many cultivated varieties. These include smooth-skinned varieties such as honeydew, Crenshaw, and casaba, and different netted cultivars (muskmelons, Persian melon, and Santa Claus or Christmas melon). The large number of cultivators of this species approach that found in wild cabbage, though morphological variation is not as extensive. It is a fruit of a type called pepo (Melopepo).

The origin of muskmelons is not known. Research has revealed that seeds and rootstocks were among the goods traded along the caravan routes of the Ancient World. Some botanists consider muskmelons native to the Levant and Egypt, while others place their origin in India or Central Asia. Still others support an African origin, and in modern times wild muskmelons can still be found in some African countries. Nowadays, the Muskmelons are cultivated in warm seasons (summer) throughout the world. [2]

The muskmelon is an annual, trailing herb. It grows well in subtropical or warm, temperate climates. Muskmelons prefer warm, well-fertilized soil with good drainage that is rich in nutrients, but are vulnerable to downy mildew and anthracnose. Disease risk is reduced by crop rotation with non-cucurbit crops, avoiding crops susceptible to similar diseases as muskmelons. Cross pollination has resulted in some varieties developing resistance to powdery mildew. Insects attracted to muskmelons include the cucumber beetle, melon aphid, melonworm moth and the pickleworm. Extensive use of natural pesticides is also recommended to prevent disease risk to the crop after bearing of fruits. [2,3]

Fig. 1. Muskmelon Fruits and Seeds

GENETICS AND OTHER VARIETIES

Muskmelons are monoecious plants. They do not cross with watermelon, cucumber, pumpkin, or squash, but varieties within the species intercross frequently. The genome of *Cucumis melo L.* was first sequenced in 2012. Some authors treat *C. melo* as having two subspecies, *C. melo agrestis* and *C. melo melo*. Variants within these subspecies fall into groups whose genetics largely agree with their phenotypic traits, such as disease resistance, rind texture, flesh color, and fruit shape. Variants or landraces (some of which were originally classified as species; see the synonyms list to the right) include *C. melo* var. *acidulus*, *adana*, *agrestis*, *ameri*, *cantalupensis*, *chandalak*, *chate*, *chinensis*, *chito*, *conomon*, *dudaim*, *flexuosus*, *inodorus*, *makuwa*, *momordica*, *reticulatus* and *tibish*. [4,6]

Not all varieties are sweet melons. The snake melon, also called the Armenian cucumber and Serpent cucumber, is a non-sweet melon found throughout Asia from Turkey to Japan. It is similar to a cucumber in taste and appearance. Outside Asia, snake melons are grown in the United States, Italy, Sudan and parts of North Africa, including Egypt. The snake melon is more popular in Arab countries. Other varieties grown in Africa are bitter, cultivated for their edible seeds. [5]

For commercially grown varieties certain features like protective hard netting and firm flesh are preferred for purposes of shipping and other requirements of commercial markets. The fruits are collected by handpicking method, they are graded as per quality, packed in suitable bags and exported for selling to the markets. [6]

NUTRIENTS FROM MUSKMELON

Table 2. Nutritional Values of *Cucumis melo L.* (Muskmelon Fruits)

Nutritional Values
Cholesterol – 0
Dietary Fibres – 0.8gm
Lipids – 0.28gm
Proteins – 0.88gm
Carbohydrates – 8.36gm
Energy (Kcal) – 35
Water – 89.7
Polyphenols
Carotenoids
Fatty Acids
(Per 100gms of an Edible Portion)

Table 3. Vitamin Contents of *Cucumis melo L.* (Muskmelon Fruits)

Vitamins (Values are expressed in IU)
Riboflavin – 0.02
Thiamine – 0.04
Pantothenic Acid – 0.13
Niacin – 0.57
Folate – 17
Vitamin A – 32 IU
Vitamin C – 42 IU

One cup of musk melon juice reportedly contains 3219 mg of cartenoids and 53 calories of energy.

MINERALS FROM MUSKMELON

Table 4. List of Minerals present in *Cucumis melo L.* (Muskmelon Fruits)

Minerals (mg)	(Values per 100gm of an edible portion)
Potassium	309
Phosphorous	17
Magnesium	11
Calcium	11
Sodium	9
Iron	0.21
Zinc	0.16
Copper	0.04
Manganese	0.05
Selenium	0.04

Muskmelon fruits are generally consumed in the summer season. It is cultivated in all the temperature regions of the world due to its good adaptation to soil and climate, its popular fruit because the pulp of the fruit is very refreshing and sweet with pleasant aroma. [7]

Various Benefits of Eating Muskmelon

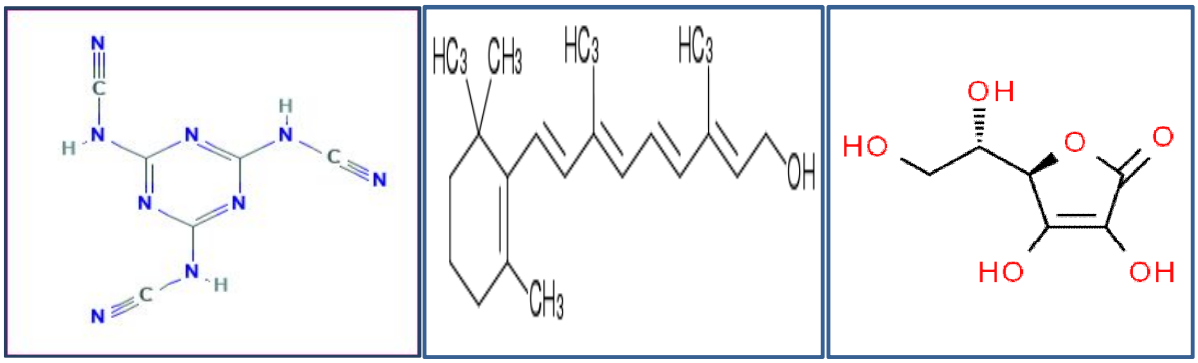
Various pharmaceutical companies announced the expansion of its Real juices and Nectars portfolio with introduction of a new flavor, real muskmelon. Muskmelon must be harvested at the proper stage of maturity to ensure maximum sweetness and quality. Muskmelon fruit has a shelf life of a week. [7]

Seeds as well as kernels are edible, tasty and nutritious, crude protein in kernel is 34.4% and Muskmelon seeds showed 33% oil in it. It proves that they are rich in protein as it shares 30.6% edible portion. Important cultivators of the musk melon in India are Punjab varieties Hara madhu, Punjab. Suheri produced the U.P varieties DM- 1, MM-28, agricultural researchers also produced the kashimadhu a total soluble solids range of from 5.7-10.7^0 bricks in muskmelon fruits. [6,7]

There is a need for better utilization of muskmelon fruits by processing them into value added products, which help to improve returns to growers and processors, Muskmelon fruit is having reasonably high sugar content and carotenoids with wide variation in soluble solids reported for different cultivars. These characteristics suggest that muskmelon fruit has the potential for being converted to processed products

with desirable flavor properties. The objectives of this investigation are to develop technologies for processing of musk melon fruits into blended jam formulations.[8]

CHEMICAL CONSTITUENTS



Tricyanmelamin **Vitamin A** **Vitamin C**

Fig. 2. Chemical Constituents of Muskmelon fruits [9]

USES

In addition to their consumption when fresh, melons are sometimes dried. Other varieties are cooked, or grown for their seeds, which are processed to produce melon oil. All varieties are grown only for their pleasant fragrance. The Japanese liqueur, Midori, is flavored with muskmelon. Muskmelon is pharmaceutically important as flavor, and research is going on for isolation and characterization of its mucilage. [6,10]

Allied Varieties [6-10]

- Bailan melon

The Bailan melon is a locally famous melon grown near Lanzhou, the capital city of Gansu province in the People's Republic of China. It is a variety of honeydew melon, globose to subglobose and typically has white skin with sweet, white or pale green, flesh. These melons appear light yellow, orange or white, with a light green or apricot yellow flesh, which makes it similar in appearance to other types in the cultivated groups of the muskmelon. It is also heavy due to the density of the fruit's inner flesh. Like other types of honeydews, the Bailan melon is rich in Vitamin C and protein.

- Barattiere – a landrace variety of muskmelon found in Southern Italy

The barattiere is a landrace variety of muskmelon (*Cucumis melo L.*) found in Southern Italy. It is common in the Apulia region of Italy and in the region of Sahel in Tunisia.

- Carosello – a landrace variety of muskmelon found in Southern Italy

The carosello is a landrace variety of muskmelon (*Cucumis melo L.*) found in Southern Italy. It is found commonly in the Apulia region of Italy.

- Crane melon

The Crane Melon is a variety that was developed in the early 1900s in Santa Rosa, California. It is grown and sold at the Crane Melon Barn in Santa Rosa. A ripe melon can grow to be about 4-7 pounds and has an orange flesh. The melon is described as "exceptionally sweet and juicy".

- Hami melon

The Hami melon is a type of muskmelon, originally from Hami, Xinjiang, China. It is also referred to as the Chinese Hami melon or the snow melon. The outer color is generally white through pink or yellow through green. The inside flesh is sweet and crisp. More than 100 cultivated forms and hybrids of the 'Hami' melon have been grown in China.

- Korean melon

The oriental melon (*Cucumis melo* Makuwa Group), also known as the Korean melon, is a type of muskmelon that is cultivated in East Asia. Phylogenetic studies tracing the genetic lineage of the plant suggest that it may have originated in eastern India, having then spread to China over the Silk Road, from which it was introduced to Korea and Japan. Its flavour has been described as a cross between a honeydew melon and a cucumber. It is noticeably less sweet than Western varieties of melon, and consists of about 90% water. The fruits are commonly eaten fresh; with its thin rind and small seeds, the melon can be eaten whole.

- Montreal melon

These melons vary greatly in size. One weighing 44 pounds has been grown. One weighing 22 pounds is also reported, which had been selected for seed purposes. Their average weight ranges from 8 to 15

pounds, and a dozen averages from 120 to 130 pounds. In exceptional cases some have been shipped weighing 240 pounds per dozen packages. The larger melons are known to be poorer in quality than those weighing 8 to 15 pounds.

- Sugar melon

A sugar melon is a type of muskmelon that is about 5–6 in (12–15 cm) in diameter and weighing between 2.5 and 4 lb (1–2 kg). Nearly round in shape, it has thick, sweet, orange flesh and a silvery gray, ribbed exterior.

Risks of eating muskmelons

In general, enjoying muskmelons poses little risk for most people. However, muskmelons have been linked to more than 10 foodborne illness outbreaks in the past 10 to 15 years, according to the Centers for Disease Control and Prevention (CDC). The majority of these incidents were bacterial infections caused by ***salmonella***, but people have also been sickened by *E.coli,* and there were some deaths reported in a multistate outbreak of listeria.

Researchers also found that 25 outbreaks were linked to the consumption of muskmelons and reported to the CDC between 1973 and 2003. These outbreaks affected more than 1,600 people, but the researchers suspect that the actual number of people sickened by eating contaminated muskmelons was probably much higher because some cases of muskmelons-related illness may never have been reported to health officials.

Muskmelons may be vulnerable to outbreaks of foodborne illness because the fruit is grown in close contact with the ground, where it may become contaminated with bacteria from the soil, water or animals before it is harvested, according to Colorado State University. In addition, the melons have a rough and textured outer surface that can trap bacteria. Bacteria can also be transmitted during the processing of pre-cut melon, from a knife cutting through contaminated rinds. If the same contaminated knife continues to be used, it can transfer bacteria to the flesh inside. Bacterial contamination is not the only possible risk from eating muskmelons. Some people with allergies to ragweed pollen may also develop symptoms of oral allergy syndrome immediately after eating melons, such as muskmelons, watermelon or honeydew.

When some people who experience ragweed allergies start to eat muskmelons, they may get an itchy feeling in their throats and lips or have swelling in their mouths, tongues and throats. This reaction occurs because the body's immune system recognizes a similarity between the allergy-causing proteins in ragweed pollen and the proteins in the food. [7]

Health benefits [7-10]

Muskmelons are not well-studied fruits till date as per society's health is concerned. Most of the research on the health benefits of the melon has focused on a person's total dietary intake of fruits and vegetables in general, or studies have looked at diets rich in specific nutrients or plant compounds found in these fruits, such as carotenoids, potassium or vitamin C. This makes it hard to draw firm conclusions about the unique health benefits of muskmelons**.**

Antioxidant power

Muskmelon fruit is a rich food source of vitamins A and C. These both are antioxidants that work to keep human body healthy. Antioxidants can have protective effects by neutralizing free radicals, which can damage DNA in cells and promote chronic inflammation in the body. Free radicals cause cell damage and disruption that can contribute to diseases. Antioxidants such as vitamins A and C may help prevent conditions such as cancer, heart disease, and arthritis.

Heart health

There is strong evidence that a diet rich in fruits and vegetables is linked with a reduced risk of heart disease and stroke, and can also lower blood pressure, according to global researchers.

Eye health

Including more fruits and vegetables in your diet can keep your eyes healthy and may help fend off cataracts and macular degeneration, two common age-related eye problems, according to global researchers**.** The vitamin A found in muskmelons is a key nutrient for good vision.

Digestion

The fiber and water in muskmelons can aid digestion and help prevent constipation, when included as part of a high-fiber diet, such as a diet rich in fruits, vegetables and whole grains.

CONCLUSION

From Current Studies on Muskmelons, it can be concluded that, Muskmelons are rich source of Potassium and vitamins. Muskmelons are also pharmaceutically important as flavours. More Research is required for determination of health benefits as well as other pharmaceutical uses of muskmelon.

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CITATION OF THIS ARTICLE

S. R. Chaudhari, U. R. Dhuppad. Nutritional and Pharmaceutical Perspectives of Muskmelon : A Comprehensive Review. Bull. Env. Pharmacol. Life Sci., Vol 9 [10] September 2020 : 11-16