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Review Article

MUSK MELON IS EAT-MUST MELON

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ABSTRACT
Benjamin Franklin, America's greatest citizen, a printer by trade, scientist and philosopher by fame said, "Women & Melons are difficult to understand". Musk melon *(Cucumis melo*) is a beautiful, juicy, tasty fruit of the Cucurbitaceae family, which includes 825 species in 118-119 genera. This family contains all the edible gourds, such as cucumbers, watermelons, Musk melons, squash, and pumpkins. Musk melon is cultivated in all tropical and subtropical areas of the world for its nutritional and medicinal value. The fruit is commonly known as Kharbooja in Hindi and Musk melon or Cantaloupe in English. The phytoconstituents from various parts of the plant include β-carotenes, apocaretenoids, ascorbic acid, flavonoids, terpenoids, chromone derivatives, carbohydrates, amino acids, fatty acids, phospholipids, glycolipids, volatile components and various minerals. *Cucumis melo* has been shown to possess useful medicinal properties such as analgesic, anti-inflammatory, anti-oxidant, free radical scavenging, anti-platelet, anti-ulcer, anti-cancer, anti-microbial, hepato-protective, diuretic, anti-diabetic, anthelmintic and anti-fertility activity. Thus, it is evident that Musk melon fruit possess a wide range of useful medicinal properties, which can be exploited clinically. The present review article covers comprehensively up-to-date information on the chemical constituents and medicinal profile of Musk melon.
KEY WORDS: Musk melon, cantaloupe, anti-inflammatory, diuretic.

INTRODUCTION

Musk melon is a beautiful, juicy, tasty and delicious fruit popular for its nutritive and medicinal properties. The Cucurbitaceae family includes squash, pumpkins, cucumbers, Musk melons, watermelons, and gourds. *Cucumis melo* (Cantaloupe or Musk melon) is one of the most important cultivated cucurbits, which is native to India and Africa. It is a spreading, annual, more or less hairy vine. It grows well in all the tropical and subtropical areas of the world, but prefers hot climate. Musk melon is recommended for the treatment of cardiovascular disorders, as a diuretic, stomachic, anti-tussive and as a vermifuge.

Brief History

Musk melon was first described by Linné in the year 1753 in species *planetarum*. It is a member of the family Cucurbitaceae represented by some 118 genera and 825 species. The origin of Musk melon has been disputed, but recent reviews strongly indicate south and east Africa as the origin of Musk melon. Musk melon has probably been cultivated in China since 2000 years BC. Several cultivars and diverse fruit forms have evolved worldwide spread in the tropical and sub-tropical regions. China and USA have the highest production of Musk melons.

Botanical Classification

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Violales
Family	Cucurbitaceae
Genus	*Cucumis* L.
Species	*Cucumis melo* L.

Natural Habitat

Musk melon is cultivated in the regions of Punjab and Rajasthan in India. Musk melon is easily spread into the forests as feral from cultivation. Natural habitats are near cultivated areas, townships and riverbeds. They grow well on a wide range of soil types. Medium-textured soils (loams) generally produce higher yields and better quality melons. In all cases the soil must exhibit good internal and surface drainage. The pH should be above 5.8 and preferably near 6.2.

Geographical Distribution

Native range - Iran, South Africa, India, China, Philippines and Australia

Exotic range - Asia: Myanmar, Japan, Korea, Nepal, Pakistan, Saudi Arabia, Sri Lanka, Thailand and Yemen, Malaysia, Indonesia, New Guinea. **Africa**: Angola, Benin, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Maldives, Mali, Nigeria, Senegal, Seychelles, Somalia, Sudan, Tanzania, Uganda, Zambia and Zimbabwe; **Pacific**: Fiji Islands, Guam, New Britain, Samoa, Solomon Islands and Tonga. **USA**: California, Arizona, Texas, Colorado, Georgia, Michigan, and New-York.

Botanical Description

The morphology of Musk melon is remarkably stable for some characters whereas, the morphology of the same organ in different fruits can be highly variable. Vines are monoecious or andro-monoecious. Musk melon vines trail along the ground, though they can be trained on a trellis or other support. Most Musk melon vines are quite large, but breeders are developing more compact cultivars. Root system is large and superficial. Stems are ridged or striate. Its sprawling branches produce broad green leaves, bright yellow flowers, and tendrils. Seeds are whitish or buff, flat, smooth, 5-15 mm long. **Fruit:** Fruits vary in size, shape and rind. The outer skin may be smooth, netted, ribbed, furrowed, yellow-brown, green, flesh yellow or pink. Ripe Musk melon fruit is nearly round, yellowish green, and rough textured. An immature Musk melon is green with a smooth rind, and may have shallow grooves depending on the cultivar. The fruits are many seeded.

Musk melon Fruits

Leaf - The Musk melon leaf is large, dark green, and rough. It is somewhat heart-shaped, orbicular, ovate, or angled with 5-7 lobes. They have 5-8 cm diameter, They are dentate and base cordate. The petioles are 4-10 cm long with simple tendrils. Musk melon leaves are sometimes confused with cucumber however, cucumber leaves (left) have sharply-pointed and toothed lobes.

Musk melon leaves

Flower - Musk melon flowers are yellow and have separate male and female flowers on the same plant. The female flower is easily identified by the small fruit (ovary) below the petals. The male flower lacks the fruit structure and falls off the plant after the pollen is shed. Flowers are staminate, clustered, pistillate, solitary or hermaphrodite with 1-3 cm diameter. calyx is 5-lobed, 6-8 mm long. Petals are free, round in shape, 2 cm long, with 3 stamens.

Musk melon flower

Phytochemistry

The unique aroma of melons is composed of many volatile compounds, biosynthetically derived from fatty acids, carotenoids, amino acids, and terpenes. The various volatile[1,2] and non-volatile phytoconstituents present in *Cucumis melo* are depicted in **Table 4** and **Table 5**.

Pharmacological Effects

Analgesic and Anti-inflammatory activity The methanolic extract of *Cucumis melo* seeds possesses potent analgesic property. Carrageenan induces accumulation of leukocytes in the pleural cavity, as well as the enhancement of LTB_4 levels in pleural exudates after inflammatory stimulus. Migration of neutrophils to the affected area constitutes an important pro-inflammatory factor, as they liberate toxic oxygen radicals in the extracellular medium. *Cucumis melo* inhibited the leukocyte influx and diminished LTB_4 levels, thereby producing anti-inflammatory effect[3].

Anti-oxidant and free radical scavenging activity The methanolic extract of cantaloupe has shown DPPH and hydroxyl radicals scavenging activity. This activity of cantaloupe extract is particularly due to the presence of phenolic compounds especially flavonoids. High antioxidant activity was observed in the leaf and stem extracts of cantaloupe[4].

Anti-ulcer activity The methanolic extract of *Cucumis melo* seeds exhibited anti-ulcerogenic activity. The mechanism of its gastro-protective activity may be attributed to reduction in vascular permeability, scavenging of free radicals and diminished lipid peroxidation along with strengthening of mucosal barrier. Presence of triterpenoids and sterols are responsible for these actions[5].

Anti-cancer activity Cucurbitacins are highly oxygenated tetracyclic-triterpenes, predominantly found in the cucurbitaceae family. Cucurbitacin B is a natural anti-cancer agent isolated from the stems of *Cucumis melo*. The anti-cancer activity of cucurbitacin B in human leukemia cells has been reported. Cucurbitacin B inhibits STAT3 activation and the Raf/MEK/ERK pathway in leukemia cell line K562. Cucurbitacin A and cucurbitacin E also possess significant anti-tumour activity[6,7].

Hepato-protective effect The dried pedicel of *Cucumis melo* L has been observed to improve hepatic function and to increase gluconeogenesis. It has a protective effect against CCl_4 intoxication. It is used to treat toxic and chronic hepatitis, jaundice and cirrhosis of liver[6].

Diuretic effect The diuretic effect of *Cucumis melo* L. was tested in anaesthetised dogs. An ether extract of the seeds significantly increased the urinary volume and its chloride content. The mechanism for this increase in chloride content may be attributed to increased glomerular filtration rate and decreased tubular reabsorption[8].

Protects against hypothyroidism Administration of three test fruit peel extracts (*Mangifera indica*, *Citrullus vulgaris* and *Cucumis melo*) significantly increased both the thyroid hormones (T3 and T4) with a concomitant decrease in tissue lipid peroxidation, suggesting their thyroid stimulatory and antiperoxidative role. This thyroid stimulatory nature was also exhibited in propylthiouracil induced hypothyroid animals[9].

Anti-diabetic activity The fruit peel extracts of *Cucumis melo* reversed the CCT-diet (supplemented with 4% cholesterol, 1% cholic acid and 0.5% 2-thiouracil) induced increase in the levels of tissue lipid peroxidation, serum lipids, glucose, creatinine kinase-MB. Furthermore, Musk melon increased the levels of thyroid hormones and insulin indicating their potential to ameliorate the diet induced alterations in serum lipids, thyroid dysfunctions and hyperglycemia/diabetes mellitus. These beneficial effects could be due to the rich content of polyphenols and ascorbic acid in the peel extracts[10]. Oxykine is the cantaloupe melon extract rich in vegetal superoxide dismutase (SOD) covered by polymeric films of wheat matrix gliadin. The treatment of oxykine ameliorated the progression and acceleration of diabetic nephropathy in type 2 diabetic rodents. The oxykine reduced the diabetes-induced oxidative stress and renal mesangial cell injury. Oxykine might be a novel approach for the prevention of diabetes nephropathy[11].

Prevention of atherosclerosis The chronic consumption of Musk melon juice helps in prevention of atherosclerosis and liver steatosis[12]. Adenosine isolated from an aqueous melon extract inhibited human platelet aggregation induced by epinephrine, ADP, collagen, thrombin, sodium arachidonate, prostaglandin endoperoxide analogue U-46619 and PAF-acether[13]. This activity of Musk melon may be helpful in the management of cardiovascular diseases.

Anti-microbial activity and anthelmintic activity The n-hexane and methanolic extracts of the seeds of *Cucumis melo* L. have shown good antimicrobial, and anthelmintic activity[14]. *Cucumis melo* is also used as a vermifuge[15].

Anti-fertility activity *Cucumis melo* is a favourite plant of Bhat community for regulating fertility[16].

Immuno-modulator The combination of SOD-rich melon extract and wheat gliadin (Glisodin®) increased specifically the production of type 1 helper T lymphocytes (Th1) as well as the expression of INF-gamma and IL-4. . However, the production of IgE (allergic) remained marginal and the production of IgA did not change, thereby reinforcing the hypothesis of the immunomodulatory action of Glisodin®. This action might result from the activation of antigen presenting cells (APC) by the gliadin-SOD combination. This activation induces the release of nitric oxide and H_2O_2, which in turn activates catalase and Gpx, followed by the expression of the INF-gamma and IL-4 cytokines. Then the immune response is modulated by the activated APC towards a Th1 response[17].

Traditional Uses

- Purgative
- Musk melon seeds are useful in painful discharges and dysuria
- Dyspepsia
- Help in maintaining kidney functions
- Reduce blood pressure and prevent cardiac dysfunction
- Possess anti-rheumatic and anti-gout properties.
- Roots (one piece in 60 gm of lime water) are an effective emetic agents
- Peduncles are used to manage anasarca and indigestion.
- Kernels are prescribed for stomach cancer.
- Useful in menorrhagia.
- Fruit pulp is employed as a lotion for chronic and acute eczema.
- The fruit can be used as a cooling agent, cleansing agent or moisturiser for the skin.

- The fruits are used as a first aid treatment for burns and abrasions.
- The flowers have expectorant property.
- The fruit is stomachic and demulcent.
- The seed is anti-tussive, febrifuge and vermifuge.
- As an immuno-modulatory agent

Miscellaneous Uses

Cantaloupe is normally eaten as a fresh fruit, as a salad, or as a dessert with ice cream or custard. In recent years, the seed kernels have been used as the basis for a number of soups and stews where they act as a thickening, emulsifying, fat binding and flavouring agents. The seed kernels are used as a dressing for breads, cakes, confectionary and snack foods, often instead of almonds and pistachios. Musk melon seeds can be substituted as an alternative to soybean for milk preparation. Musk melon is applied for removing tan and freckles. The flesh of the fruit can be dried, ground into a powder and used with cereals for making bread, biscuits etc.

Strange Facts

- Cantaloupe was named after the city Cantalupo (Italy), where cantaloupe was originally cultivated from Armenia melon seeds
- Musk melons are in the same gourd family as squashes and cucumbers
- Cantaloupe is a juicy, sweet alternative for dessert
- Cantaloupe is the most popular melon in the United States
- A squirt of lemon or lime juice perks up the flavour of a slice of cantaloupe
- There are six common sizes of cantaloupe. The sizes are 9, 12, 15, 18, 23 and 30. They are grouped into specific sizes based on their weight and the number that can fit into a 40-pound case or cardboard shipping box. A size 12 means that there are 12 cantaloupes of similar weight, approximately 3¼ lbs., in a 40-pound box. The smaller the number, the larger the cantaloupe.
- Leaving uncut cantaloupe at room temperature for two to four days, makes the fruit softer and juicy

CONCLUSION

Benjamin Franklin, America's greatest citizen, a printer by trade, scientist and philosopher by fame said, "Women & Melons are difficult to understand". Musk melon is a beautiful, juicy, tasty and delicious household fruit consumed for its nutritive and medicinal properties. Pharmacological studies conducted on *Cucumis melo* indicate its immense potential in the treatment of conditions such as pain, inflammation, cardiovascular disorders, liver diseases, cancer, coughs, and dysuria. Musk melon exhibits excellent anti-oxidant potential. It is very clear that this plant has tremendous popularity now and also holds extraordinary promise for the future. In view of the low toxicity of Musk melon and their use as a nutraceutical as well as a reliable medicine, clinical studies need to be carried out only to cement *Cucumis melo* as an important component of our biodiversity. Since, no side-effects have been reported till date, Musk melon can be looked upon as a unique, affordable, safe and tasty fruit medicine.

REFERENCES

1. Homatidou VI, Karvouni SS, Dourtoglou VG, Poulos CN. Determination of Total Volatile Components of *Cucumis melo* L. Variety Cantaloupensis. J. Agrlc. Food Chem. 1992; 40: 1385-1388.
2. Kourkoutas D, Elmore JS and Mottram DS. Comparison of the volatile compositions and flavour properties of cantaloupe, Galia and honeydew musk melons. Food Chemistry. 2006; 97 (1): 95-102
3. Gill NS, Bajwa J, Sharma P, Dhiman K, Sood S, Sharma PD, Singh B and Bali M. Evaluation of therapeutic potential of traditionally consumed *Cucumis melo* seeds. Asian Journal of Plant Sciences. 2011; 10 (1): 86-91.
4. Ismail HI, Chan KW, Mariod AA and Ismail M. Phenolic content and antioxidant activity of cantaloupe (*Cucumis melo*) methanolic extracts. Food Chemistry. 2010, 119 (2): 643-647
5. Gill NS, Bajwa J, Sharma P, Dhiman K, Sood S, Sharma PD, Singh B and Bali M. Evaluation of antioxidant and anti-ulcer activity of traditionally consumed *Cucumis melo* seeds. Journal of Pharmacology and Toxicology; 2011; 6 (1): 82-89.
6. Wang J, Zhou X, Cao Y, Xiao J, Ma E, Deng Y, Chen D. The antitumor activities of Cucurbitacin Liposome for Injection both *in vitro* and *in vivo*. Asian Journal of Traditional Medicines. 2007; 2 (3): 98-103.
7. Chan KT, Li K, Liu SL, Chu KH, Toh M, Xie WD. Cucurbitacin B inhibits STAT3 and the Raf/MEK/ERK pathway in leukemia cell line K562. Cancer Lett.2010; 289 (1):46-52.
8. Wright CI, Van-Buren L, Kroner CI, Koning MM. Herbal medicines as diuretics: a review of the scientific evidence. J Ethnopharmacol. 2007; 114 (1): 1-31.
9. Parmar HS and Kar A. Protective role of *Mangifera indica*, *Cucumis melo* and *Citrullus vulgaris* peel extracts in chemically induced hypothyroidism. Chem Biol Interact. 2009; 177 (3): 254-258.
10. Parmar HS, Kar A. Possible amelioration of atherogenic diet induced dyslipidemia, hypothyroidism and hyperglycemia by the peel extracts of *Mangifera indica*, *Cucumis melo* and *Citrullus vulgaris* fruits in rats. Biofactors. 2008; 33 (1): 13-24.
11. Naito Y, Akagiri S, Uchiyama K, Kokura S, Yoshida N, Hasegawa G, Nakamura N, Ichikawa H, Toyokuni S, Ijichi T, Yoshikawa T. Reduction of diabetes-induced renal oxidative stress by a cantaloupe melon extract/gliadin biopolymers, oxykine, in mice. Biofactors. 2005; 23 (2): 85-95.

12. Dé cordé K, Ventura E, Lacan D, Ramos J, Cristol JP, Rouanet JM. An SOD rich melon extract Extramel® prevents aortic lipids and liver steatosis in diet-induced model of atherosclerosis. Nutr Metab Cardiovasc Dis. 2010; 20 (5):301-7.
13. Altman R, Rouvier J, Weisenberger H. Identification of platelet inhibitor present in the melon (Cucurbitaceae *Cucumis melo*). Thromb Haemost. 1985; 53 (3):312-3.
14. Ibrahim SR. New 2-(2-phenylethyl) chromone derivatives from the seeds of *Cucumis melo* L var. *reticulatus*. Nat Prod Commun 2010; 5 (3): 403-6
15. Zinchenko TV, Mindlin MZ, Prokopovich NN. Anthelmintic properties of *Cucumis melo* seeds. Farmakol Toksikol. 1955; 18 (5): 41-43.
16. Lal D and Lata K. Plants used by the Bhat community for regulating fertility. Econ Bot. 1980; 34 (3): 273-275.
17. Vouldoukis I, Conti M, Kolb JP, Calenda A, Mazier D and Dugas B. Induction of Th1-dependent immunity by an orally effective melon superoxide dismutase extract. Curr Trends Immunol. 2003; 5: 141-145
18. Stepansky A, Kovalski I and Perl-Treves R. Intraspecific classification of melons (*Cucumis melo* L.) in view of their phenotypic and molecular variation. Plant Systematics & Evolution. 1999; 217: 313-333.
19. Fleshman MK, Lester GE, Riedl KM, Kopec RE, Narayanasamy S, Curley RW, Schwartz SJ, Harrison EH. Carotene and Novel Apocarotenoid Concentrations in Orange-Fleshed *Cucumis melo* Melons: Determinations of β-Carotene Bioaccessibility and Bioavailability. J Agric Food Chem. 2011; 59 (9): 4448-4454.
20. Tadmor Y, Burger J, Yaakov I, Feder A, Libhaber SE, Portnoy V, Meir A, Tzuri G, Sa'ar U, Rogachev I, Aharoni A, Abeliovich H, Schaffer AA, Lewinsohn E, Katzir N.Genetics of flavonoid, carotenoid, and chlorophyll pigments in melon fruit rinds. J Agric Food Chem. 2010; 58 (19): 10722-10728.
21. Ismail M, Mariod A, Bagalkotkar G, Hoe SL. Fatty acid composition and antioxidant activity of oils from two cultivars of Cantaloupe extracted by supercritical fluid extraction. Grasas Y Aceites. 2010; 61 (1): 37-44
22. Hu Mian-hao, Ao Yansong. Characteristics of some nutritional composition of melon (*Cucumis melo* hybrid 'ChunLi') seeds. International Journal of Food Science and Technology. 2007; 42: 1397-1401.
23. Keng CL, Hoong LK. *In vitro* plant regeneration from nodal segments of musk melon (*Cucumis melo* L). Biotechnology, 2005; 4 (4): 354-357
24. Hemavatahy J. Lipid composition of melon (*Cucumis melo*) kernel. Journal of Food Composition and analysis. 1992; 5 (1): 90-95.
25. Chen C, Qiang S, Lou L, Zhao W. Cucurbitane-type triterpenoids from the stems of *Cucumis melo*. J Nat Prod. 2009; 72 (5):824-9.
26. De Marino S, Festa C, Zollo F and Iorizzi M. Phenolic glycosides from *Cucumis melo* var. *inodorus* seeds. Phytochemistry Letters. 2009; 2 (3): 130-133.
27. Lee CF, Lin JY. Amino acid sequences of trypsin inhibitors from the melon *Cucumis melo*. J Biochem. 1995; 118 (1): 18-22.

Table-1: Synonyms In Indian Languages

Sr.	Name	Language	State/Region
1	Kharbooja, Kherbuj	Hindi, Punjabi, Haryanvi	Punjab, Haryana, Delhi, U.P.
2	Chibunda, Tarkaddi	Marathi	Maharashtra
3	Thumattikai, mulampazham	Tamil	Tamil Nadu
4	Budame Kayi, kakkarike	Kannada	Karnataka
5	Kharmuj	Bengali	West Bengal
6	Tarbucha, Sakkarteti	Gujarathi	Gujarat
7	Madhuphala, Vrittakarkatii,	Sanskrit	India
8	Chiral	Assamese	Assam
9	Thai Kumbalom	Malayalam	Kerala

Table-2 INTERNATIONAL SYNONYMS

Sr.	Name	Language	Country/Region
1	Musk melon	English	U.K
2	Cantaloupe	English	USA
3	Cantaloupe	Arabic	Egypt, Iraq
4	Ying pi tian gua	Chinese	China
5	Melon	Danish	Denmark
6	Kanteloep, knobbelmeloen	Dutch	Netherland, Belgium
7	Cantaloup, melon cantaloup	French	France, Haiti
8	Kantaloupe/Rippen-melone	German	Germany
9	Melone cantalupo	Italian	Italy
10	Kantarohpu	Japanese	Japan
11	Tembikai wangi	Malay	Malaysia
12	Melão cantalupe	Portuguese	Portugal
13	Melón cantaloupe	Spanish	Spain, Mexico, Peru
14	Melon	Tagalog	Philippines

Table-3 DIFFERENT VARIETIES[18] OF MUSK MELON

Sr.	Variety	Plant Characteristics
1.	***C. melo* var. *agrestis***	Thin-stemmed, monoecious plants growing as weeds in African and Asian countries. Very small (<5 cm), inedible fruits with very thin mesocarp and tiny seeds.
2.	***C. melo* var. *cantalupensis***	Medium-large size fruits, smooth, scaly or netted rind of variable colour. Fruits are aromatic with sweet, juicy flesh, and abscise at maturity. Andromonoecious flowering in most genotypes, hairy ovary. Includes dessert melon types such as Galia, Ananas, "American shippers".
3.	***C. melo* var. *inodorus.***	Large-sized winter melons, with non-aromatic, non-climacteric and long storing fruits, with thick, smooth or warty rind. Includes sweet dessert melons from Asia and Spain, such as Honeydew and Casaba type-cultivars. Usually andromonoecious, hairy ovary.
4.	***C. melo* var. *flexuosus.***	Fruits are very elongated, non-sweet, eaten immature as cucumbers. Found in the Middle East and Asia. Usually monoecious.
5.	***C. melo* var. *conomon***	Far-Eastern cultivars, where the smooth, white-fleshed, thin rinded fruits are eaten as pickles. Andromonoecious vines bear dark, spiny leaves, sericeous ovaries.
6.	***C. melo* var. *chito* and *dudaim***	The former was reportedly of American feral origin, with small plum-size, aromatic fruits used as pickles, monoecious vines and sericeous ovaries. The second is of Persian origin, andromonoecious, sericeous ovaries, bears small, aromatic, red or brown-striped fruits, grown as ornamentals in Oriental gardens.
7.	***C. melo* var. *momordica.***	Indian accessions with monoecious vines, sericeous ovaries and large, non-sweet fruits with thin rind that splits at maturity.

Table-4 VOLATILE COMPONENTS PRESENT IN MUSK MELON

Sr.	Volatile Components
1.	**Aliphatic Esters:** Methyl acetate; Ethyl acetate; Propyl acetate, etc.
2.	**Aliphatic Alcohol:** Ethanol; (Z) -3-Hexenol; 1-Hexanol; Nonenol; Nonanol etc.
3.	**Aldehydes, Ketones:** Hexanal; 2-Ethylbutanal; 6-Methyl-3-heptanone etc.
4.	**Aromatic Aldehydes, Ketones:** Benzaldehyde; Phenylacetaldehyde etc.
5.	**Aromatic Esters:** Benzyl acetate; Phenylmethyl acetate etc.
6.	**Aromatic Alcohols:** Benzyl alcohol; Phenyl ethyl alcohol etc.
7.	**Lactones (γ,δ):** γ –Octalactone; δ –Nonalactone etc.
8.	**Phenols:** Eugenol
9.	**Sulphur compounds:** Dimethyl disulfide; 2-(Methy1thio)ethanol etc.
10.	**Terpenoids:** β-Pinene; 1,8-Cineol; Limonene; γ-Terpinene, p-Cymene etc.
11.	**Cyano Compounds:** Benzyl cyanide; 3-(Methylthio) propanenitrile

Table-5 NON-VOLATILE PHYTOCONSTITUENTS OF MUSK MELON

Sr.	Chemical Constituents	Source
1	**β-Carotenes and Apocarotenoids**[19]	Fruit
2	**Phenolic compounds**[20,21]**:** Flavonoids	Fruit, leaf, stem, seed
3	**Carbohydrates**[21,22]	Fruit, Seed
4	**Vitamin C (Ascorbic acid)**[23]	Fruit
5	**Fatty acids**[21]**:** Linoleic acid, α-Linolenic acid etc.	Seed
6	**Glycolipids**[24]**:** Monogalactosyldiacylglycerol, Digalactosyl-diacylglycerol etc.	Kernel
7	**Phospholipids**[24]**:** Phosphatidylcholine, Phosphatidyl-ethanol-amine etc.	Kernel
8	**Amino Acids**[22]	Seed
9	**Cucurbitacins (A,B and E)**[6,25]	Stem
10	**Phenolic Glycosides**[26]	Seed
11	**Chromone derivatives**[14]	Seed
12	**Minerals**[23]**:** Iron, Zinc, Copper, Manganese, Calcium, Potassium and Phosphorous	Fruit, seed
13	**Trypsin inhibitors (CMeTI-A and CMeTI-B)**[27]	Seed

Fig. 1 Musk melon Ice cream