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Use of melon peels as fortified food

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Abstract

Melon peels, treated as waste of melon by average people generally, is now a big serious concern as the melon peels contain high amount of carbohydrate (cellulose, hemicelluloses and lignin) in its solid part and a huge amount of protein in its pellet area. The peels are also looked over cell wall modifying and browning enzymes, furthermore for total polyphenols, ortho-diphenols, flavonoids, tannins, and antioxidant properties. The peels are also rich in many nutrients like Vitamin C, Carotenoid, Potassium, Magnesium etc. In addition, the peels extract has antimicrobial properties against many microbes (e.g. *Staphylococcus albus*, *Enterococcus faecalis*, *E. coli*, *Listeria innocua* etc.). The main purpose of this paper is to show that the melon peels can be used as a fortified food for its natural nutrients and it should not be thrown away as waste products. Not only the melon peels but also their extract is likely to be used as functional food ingredients which would be beneficial for human health.

Keywords: Antioxidant, fortified food, melon peels, microbes, waste

Introduction

Peels of any fruits or vegetables are that part which act as a protective layer and are peeled off. So, it means that the outer most covering of watermelon which is the toughest part and green in color is the melon peels and previously it was treated as food wastes. But it has been seen that, the natural resource losses are successfully decreased by the recycling method of agricultural and food waste and thus leading to the evolution of new Green markets via the inauguration of renovated products (Vella *et al.*, 2023) [8]. As the melon peels contain adequate amounts of vitamins, minerals, fibre, citrulline as well as high amount of protein, carbohydrate, moisture, it can be valorized in different forms and used as a source of nutrient in evolving food products rather than throwing them away. Many studies had proven that the extract of melon peels can be used as a functional food or fortified food ingredient for giving assistance to human health as well as increasing the shelf life of foods (Vella *et al.*, 2023) [8]. The foods with various types of nutrients added to them called Fortified food. So, food fortification is the application of knowingly increasing the content of one or more micronutrients (such as vitamins, minerals) in a food improving the nutritional quality of food supply and providing a public health benefit with lower life risk.

2. Nutritional benefits of melon peels

The nutritional and mineral contents present in peels of melon are in the following (Zhivkova *et al.*, 2021) [9]:

Nutrients	Amount
Digestible Carbohydrates	5.8%
Total Sugars	4.40%
Reducing Sugars	3.22%
Dry matter	9.2%
Free Fat	0.19%
Water content	92.7%
Magnesium (Mg)	466 mg/kg
Aluminium (Al)	3.11 mg/kg
Calcium (Ca)	720 mg/kg
Boron (B)	2.10 mg/kg
Sodium (Na)	83.1 mg/kg

In research, it has been proved that the melon peels are rich in bioactive compounds, mainly polyphenols including flavonoids and phenolic acids and are also loaded with fatty acids

such as oleic acid, linoleic acid, palmitoleic acids and carotenoids such as alpha-carotene, beta-carotene and beta-cryptoxanthin (Gomez-Garcia *et al.*, 2021) [4]. The melon peels contain non-essential amino acid Citrulline which is lower than the watermelon flesh and the rind and the amount of citrulline in different part of watermelon are shown below through a pie chart:

Citrulline has a powerful antioxidant action and is a precursor of arginine in the nitric oxide pathway. Citrulline takes a vital part in the urea cycle, assisting the body by eliminating harmful substances, especially ammonia. The amounts of vitamins present in the melon peels are as follows (Askarov *et al.*, 2022) [11].

Type of Vitamins	Amount
Vitamin B4	63 mg
Vitamin B12	7.3 mg
Vitamin B2	2.96 mg
Vitamin E2	18 mg
Vitamin B6	2.03 mg
Vitamin B5	0.75 mg
Vitamin B9	0.64 mg
Vitamin C	0.32 mg
Vitamin K	7.32 mg
Beta-Carotene	9 mg

Uses of melon peels

A lot of varieties of drinks and foods can be made by using

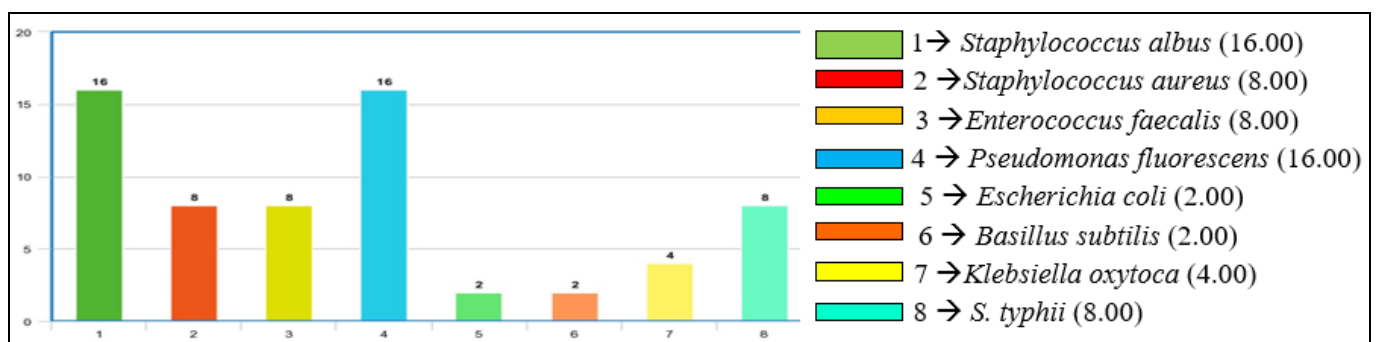
melon peels or melon skin. Some of them are given below with proper cooking instructions:

Items	Steps
Watermelon skin juice	Mix some melon peels with water → strain the pulp → add sugar, salt, pepper and lemon juice as per taste
Watermelon peel bhaji	Chop the rinds into about 1'' pieces after trimming off red flesh from melon rinds → heat ghee or grape seed oil over high heat in a nonstick frying pan → add black mustard seeds, cumin seeds, asafetida, ground turmeric and chillis after trimming the stem ed from chillis → add melon rind with peel into the spices when they will begin to darken in color → stir to coat in spices since spread into an even layer → do not flip the pieces until the bottom becomes golden brown → add salt as required
Watermelon Candy	Keeping light green parts, cut thin green skin off the watermelon → slice the melon into thinner pieces → add water and sugar in a pan and mix well → stir the pieces after adding them in pan → cook up to 40 minutes on low flame → move the cooked melon pieces on the oven rack → bake for at least 2 hours at 50° C → mix with sugar by dipping the baked melon pieces in bowl
Pickle	Slice the watermelon rind with the peel thinly → add vinegar → add water by bringing it to simmer → pour hot mixture over top of melon rinds → keep them in fridge for at least 6 hours to 3 days after sealing the jar where the pieces were kept.

Advantages

- In a study, it has been proven that the watermelon peels (WMP) contain significant free radical scavenging activity by doing DPPH(1,1-diphenyl-2-picrylhydrazyl-2,2-diphenyl-1-picrylhydrazyl) analysis and also WMP may be considered as a good source of antioxidants, polyphenols and minerals (Feizy *et al.*, 2020) [3].
- It has been proved that, pectin extract from WMP if incorporated with beetroot extract, it gives freshness to the packaged chilled beef which is highly perishable

- because of its exposure to the conditions that are not favorable (Guo *et al.* 2021) [5].
- The peels of watermelon contain the highest antimicrobial activity as well as the peels also carry total phenolics compound in such a significant level which are responsible for plethora of medicinal properties in plants. According to research, the least inhibitory concentration of methanol extracts (mg/ml) against some micro-organisms in peels are shown below (Neglo *et al.*, 2021) [6].

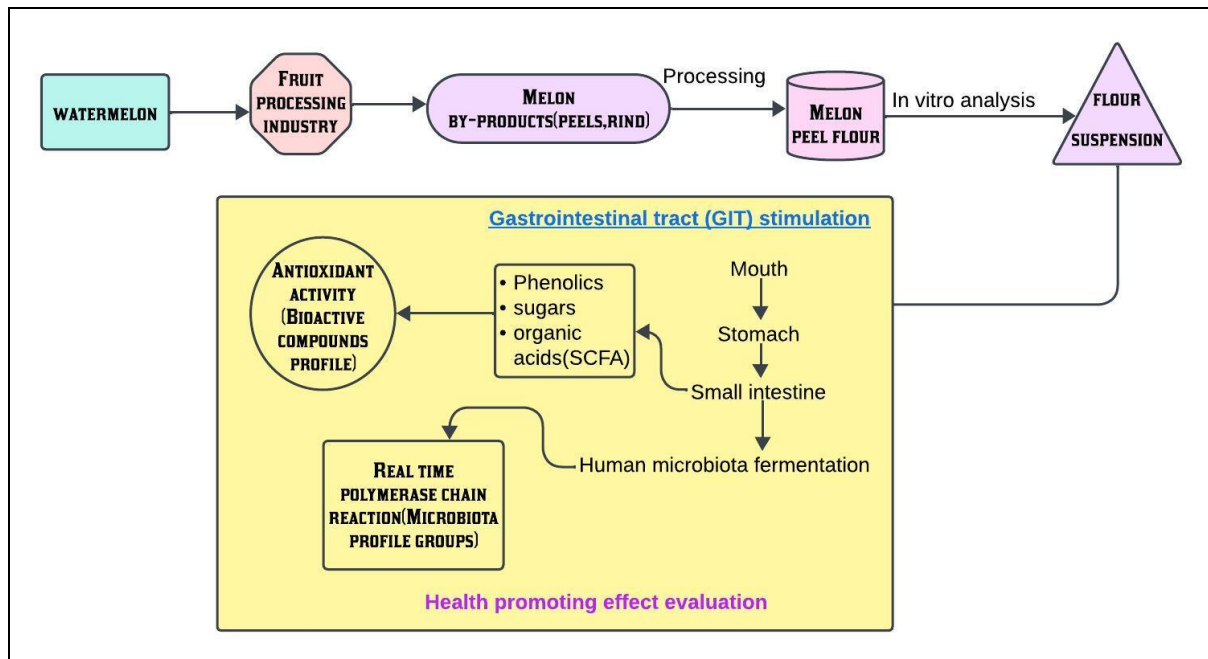


- Antioxidants such as polyphenols, polysaccharides, carotenoids as well as some vitamins including Vitamin A, C, found in Watermelon peel extract, can take part in the prevention of damaging DNA, RNA (when the Reactive oxygen Species (ROS) attack these

- biomolecules in the liver cell) via several mechanisms such as by neutralizing or scavenging free radicals (Elhassaneen *et al.*, 2022) [2].
- The melon peels have prebiotic potential imputed to the phenolic compounds and the manufacture of fatty acids

beneficial for our health which can boost human gut health. The melon peels flour extracted from solid fraction may exhibit an increase in antioxidant capacity at gastric and intestinal phase which is due to the

presence of increased total phenolic content and individual phenolics including tyrosyl, luteolin-6-glycoside, chlorogenic and caffeic acid (Gomez-Garcia *et al.*, 2022) [4].



- Citrulline is an intermediate product produced from the urea cycle and its function is to help the body by getting rid of toxic substances like urea and besides this, it has an important role in vasodilation (widening of blood vessels) and muscle building.

Disadvantages

- As the watermelon peels contain high fibre, it should not be given before adulthood because ingestion of higher fibre may be inversely connected with allergic rhinitis in mid-childhood (Sdona *et al.*, 2022) [7].
- Consumption of a huge amounts of watermelon peel can lead to problem in digestive system such as bloating, cramping and diarrhea.

Conclusion

Melon peels now-a-day can no longer be considered as a waste product. Instead of that, the melon peels being fortified can be used as a nutraceutical product. A lot of beneficial components are present in these peels which can be used as an antioxidative food compound with a higher shelf life and greater health impacts. These peels are also being potential to improve gut health with high antimicrobial activity. Melon peels can be included in diet with various modified recipes along with beverages. As the melon peels contain high dietary fibre, so it may be considered to have anti-diabetic effects and hypocholesterolemic effects as well as gives a beneficial impact on obesity, atherosclerosis and improves cardiovascular health. As a conclusory statement, it has been proven that, the melon peels, once considered as a waste product, now takes up a huge place in newer food technology and will show a lot of therapeutic prospectives in coming future.

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