

## Review Article

# Utilization of Watermelon Rind (*Citrullus lanatus*) in Various Food Preparations: A Review

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**Abstract**

*Citrullus lanatus*, commonly known as watermelon, is most nutritious fruit belong to Cucurbitaceae family and originated from Kalahari Desert of Africa for more than 4,000 years. Being comprises of more than of 92% water, it is considered as a refreshing, thirst-quenching appetizer with significant nutrient balance. The white part of the rind is a good source of fiber, which aids in digestion. Since the rinds are lower in sugar and higher in fiber than the actual melon, when eaten together they help slow down sugar absorption in the gut. Not only do watermelon rinds contain all the same nutrients as is found in the juicy fruit, but even higher concentrations of certain antioxidants, minerals, vitamins, and active ingredients. Various studies have reported that the peel of watermelon is rich source of fibers and nutrients and possess ability to be utilized in various food products. The purpose of this review is to highlight the underutilized portion of watermelon with its chemical properties and provide way for future research with it.

**Keywords:** *Citrullus*, Utilization, benefits, uses**\*Correspondence**

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**Introduction**

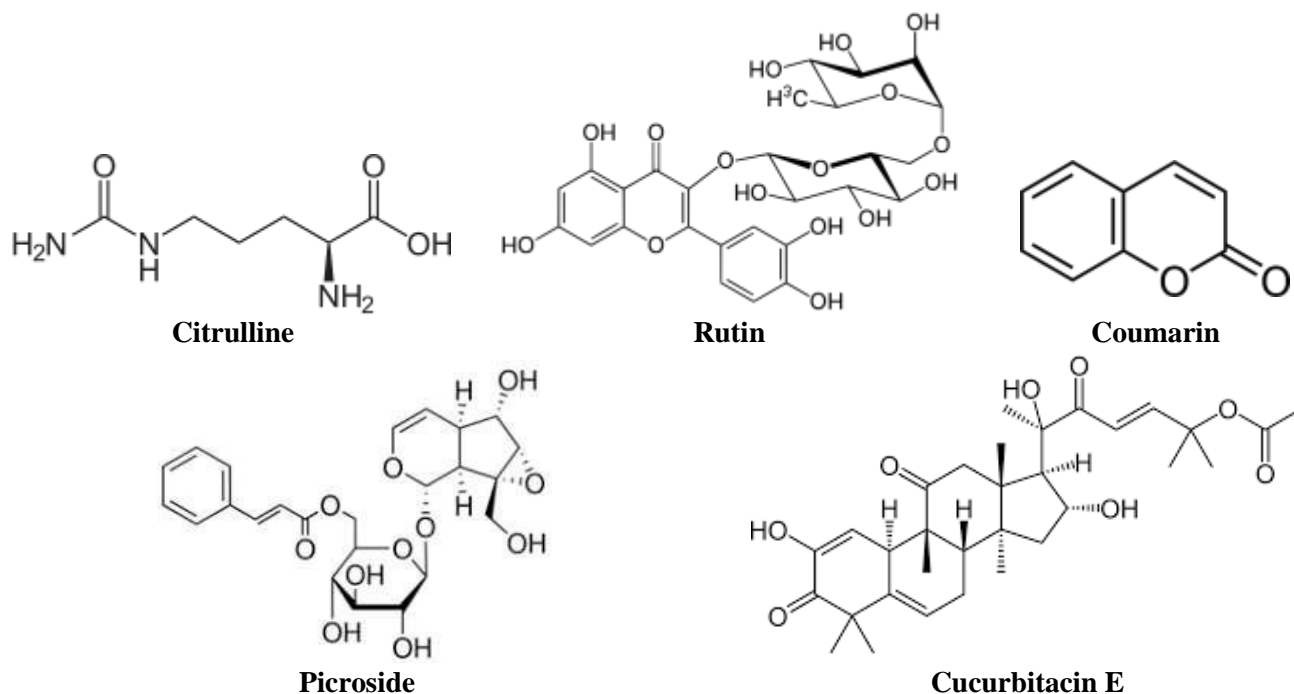
Watermelon scientifically known as *Citrullus lanatus*, a thirst-quenching fruit belongs to the Cucurbitaceae family originated from Kalahari Desert of Africa for more than 4,000 years [1] and a highly cultivated fruit worldwide, with more than 1,000 varieties. Watermelon can be grown during warm season with plenty of rainfall. For optimum growth, it requires a lot of sunshine and high temperature of over 25°C. Since *Citrullus lanatus* contain about 93% water, therefore commonly called “water” melon. And the “melon” part defines the fruit to be large and round with sweet, pulpy flesh. The skin is a smooth, with dark green rind or every so often light green stripe that becomes yellowish green when ripe. Watermelon is an exceptionally rich in nutrients, can be served for breakfast, as an appetizer or snack [2]. Watermelon is one of the major under-utilized fruits, the juice or pulp from watermelon is used for human utilization, while rind and seeds are major solid wastes of fruit industries [3-5]. The most important watermelon producing areas are the Middle East, the USA, Africa, India, Japan, and Europe. According to the National Institute of Industrial Research, watermelon is cultivated in Rajasthan, Uttar Pradesh, Orissa, Punjab, Haryana, Assam, West Bengal, Karnataka, Orissa, Gujarat, Andhra Pradesh, Maharashtra, Himachal Pradesh and Tamil Nadu.

The common name of watermelon is Tarbooz (Hindi and Urdu), Tarbuj (Manipuri), Kaduvrindavana (Marathi), Eripuctcha (Telegu), Kallangadiballi (Kannada), Tormuj (Bengali), Indrak (Gujarati). India grows approximately 25 commercial varieties, a few of which have delightfully interesting names: New Hampshire Midget, Madhuri 64, Black Magic, Sugar Baby, Asahi Yamato, Arka Jyoti, Arka Manik, Improved Shipper, Durgapura Meetha and Durgapura Kesar to name a few. Watermelon is grown in sandy loam soil rich in organic matter with good drainage and pH range for 6.5-7.5 [6]. In North Indian plains, watermelons are sown in February-March whereas in Northeastern and Western India best time of sowing is from November to January. In South and Central India, these can be grown almost round the year.

**Nutritional value of fresh watermelon**

Watermelon is one of the commonly consumed fruits in many countries. Watermelon contains more than 91% water and up to 7% of carbohydrates. It is a rich source of lycopene and citrulline. Watermelon rind contains more amounts of citrulline than flesh. Additionally, watermelon has a number of essential micronutrients and vitamins. The amino acid citrulline had been first extracted from watermelon and analyzed. The nutritional quality of watermelon shows that it is very rich in vitamins A, different vitamins from vitamin B complex like Thiamine, Riboflavin, Niacin, Pantothenic acid, vitamin B6 and Folate, Vitamin C. The mineral composition is Calcium, Iron, Magnesium,

Phosphorus, Potassium and Zinc, it also contains highly unsaturated fatty acids and oils, It also rich in necessary amino acids like arginine, glutamine and aspartic acid [7]. The plant is also rich in alkaloids, flavonoids, glycoside, saponins, tannins and phenols. Its nutritive values are also useful to the human health. Other constituent present Cucurbitacin E is a unique anti-inflammatory agent found in watermelon which reduces the risk of certain types of cancer in humans [8].



## Health benefits of watermelon

### *Healthy Heart*

Watermelon is rich source of antioxidant, lycopene which protects the cell from damage and reduce the risk of heart disease. It is also rich source of minerals which confers heart health, one such is potassium, which forms the component of cell and helps in moderating the blood pressure and keeps heart healthy [9].

### *Hydration and digestion*

As mentioned, watermelons comprise of more than 90% of water, which helps to keep the body hydrated and balance the electrolyte levels in body fluid. It is the best thirst quenching in summer season. Watermelon has significant number of fibers which helps in digestion and regulated bowel movement.

### *Anti-inflammatory and antioxidant support*

Presence of carotenoids and lycopene in watermelon, makes it a rich source of antioxidant. Anti-inflammatory activity of fruit is attributed to the presence of lycopene, and it also acts as antioxidant by neutralizing free radicals. Watermelon also consists of significant amount of Vitamin A which contributes towards antioxidant activity.

### *Anti-cancer activity*

Presence of lycopene makes it as effective anti-cancer agent. As per the report obtained by National Cancer Institute, Lycopene help in reducing prostate cancer cell proliferation.

### *Reduces body fat*

The Citrulline present in watermelon helps to reduce the body fat after converting into arginine. And reduces the fat, and thus block the activity of TNAP (tissue non-specific alkaline phosphatase) which prevents the accumulation of fat [8].

## **Utilization of watermelon rind in food products preparation**

### ***Watermelon rind incorporated Fruit Butter***

According to a study [10], Development of watermelon incorporated fruit butter, Watermelon rind can be a replacing one to prepare fruit butter. Different fruit butter formulations with the ratios of 100:0, 75:25, 50:50, 25:75 and 0:100 (Apple : watermelon rind) were prepared. The preparation involved cooking of 300gm Sugar with 400gm watermelon rind pulp with some spice mixture (nutmeg, cinnamon and clove) and citric acid. The prepared product undergone organoleptic evaluation and out of 4 ratios, Sample 4 (0:100) was accepted when compared to apple butter. Hence, 100 % watermelon rind can be incorporated for preparation of nutritious and acceptable fruit butter.

### ***Watermelon rind flour-based Cookies***

On the basis of nutritional and health benefits of watermelon rind, Cookies were prepared by incorporating watermelon rind flour at different levels – 10%, 20% and 30% and compared to 100% refined wheat flour [11]. Processing of Cookies comprises of dry ingredients mixing along with watermelon rind flour and refined wheat flour and kneaded to dough. It is subjected to rolling and cutting followed by baking at 160 °C for 20 minutes. As a result, 30 % watermelon rind incorporated cookies were best accepted on the basis of nine - point hedonic scale with 8.04 score. Therefore, watermelon rind flour can partially alter the refined wheat flour which can be a best novel product and can advance the nutritional quality of crude fiber, calcium, iron and phosphorous of product and also add variety to the diet.

### ***Watermelon rind Dehydrated Candy***

Muhamad et al [12] developed technology using osmotic dehydration for Dehydrated Candy from Watermelon rind. The blanching was done on 3 cm long and 1 cm wide pieces of watermelon rind for 1 min followed by dipping it in 40 ° Brix sugar syrup with daily increment of 5 ° Brix up to 55 Brix. Crystallized rinds were kept at 50 °C in cabinet drying for 8, 14 and 20 hours respectively and finally coated with icing sugar and corn flour (1:1). Results showed that 14 hours kept dehydrated candies were the most acceptable.

### ***Reduced Fat Mayonnaise***

Due to satisfactory level of pectin, watermelon rind can act as a stabilizing agent in preparation of food products [13]. Watermelon rind can be formulated in flour and acts as a stabilizer in the preparation of mayonnaise. Study involves the preparation of 4 treatments, 0% watermelon rind, 2%, 4% and 6% with 50% oil in each treatment. Results of organoleptic evaluation revealed that use of 2% watermelon rind is suitable for mayonnaise preparation [14].

### ***Watermelon rind enriched Novel Biscuits***

Ogo et al [15] incorporated watermelon rind and orange pomace in the development of wheat enriched Biscuits in the following ratio 100:0:0; 90:5:5; 80:10:10; 70:15:15 and 60:20:20 as an effective value addition to food by improving the nutritional quality of biscuits. The composite flour formulated from wheat flour, watermelon rind and orange pomace flour and dry ingredients mixing were done to form dough. The kneaded dough was subjected to rolled out into biscuits of 3cm diameter followed by baking at 160 °C for 20 minutes. The Biscuits was rated good in sensory test.

### ***Watermelon rind Cake***

A study was carried out to utilize the watermelon rind as a functional ingredient in cake processing by substitute the wheat flour with 5, 10 and 15% of watermelon rind powder and 100% of wheat flour. All the ingredients were mixed together and then baked at 180 °C for 30 minutes. After organoleptic evaluation, 5% and 10% formulations were most acceptable. Thus, watermelon rind powder could be used as a functional ingredient due to their nutritional health benefits [16].

### ***Watermelon rind incorporated Dietary chips***

A novel method of watermelon rind dietary chips was conducted. In the preparation of chips, initially watermelon rind was made and mixed with composite flour (masoor dal, moong dal, channa dal, and soybean dal), salt and pepper and dough were prepared with different ratio combinations. Desired shapes of chips were cut and baked at 270 °C for 5

minutes. As a result, Ratio of 32:68 of watermelon rind and composite flour was best among all the trials and consist to have more dietary fiber and low-fat content. Thus, watermelon could be used as partially substitution to the fat or flour used to prepared chips [17].

### ***Watermelon rind flour-based Bread***

To enhance the nutritional quality of bread, a study was done to prepare bread by using watermelon rind flour blend with composite flour at different quantity - 0%, 10%, 20%, 30%, 40%. The straight dough method was used to prepare bread. Dough was prepared by blending all the ingredients and baked at 100° C for 1 hour 25 minutes. As a result, it concluded that by incorporating watermelon rind flour upto 10% to 30% not only enhance the nutritional quality of the bread but also helps to resolve malnutritional quality as well as decrease waste coming from fruit industry and the end product found to be satisfactory [18].

### ***Addition of watermelon rind powder in Sorghum based Mumu***

Mumu, traditional Nigerian cereal-based ready to eat food product prepared from maize, millet and sorghum [19]. In this study, initially 3 different samples – roasted sorghum flour [20], roasted partially defatted groundnut flour [21] and watermelon rind powder [22] were prepared respectively by different methods. Four combinations of different ratios 85:15:0, 75:15:10, 70:15:15 and 65:15:20% of roasted sorghum flour, roasted partially defatted groundnut flour and watermelon rind powder were made [23]. From the following powdered form blend Mumu was prepared by mixing it with cold water and sugar for taste in required amount. As a result, functional, pasting and microbial qualities of the product become much better by the addition of watermelon rind powder.

### ***Watermelon rind low-fat Muffins***

The utilization of watermelon rind as fat replacer for the preparation of low-fat muffins by enriching its nutritional content is the aim of this study [24]. Initially watermelon rind powder was prepared and hydrated with milk in 1:4 ratio to form the paste as a fat replacer. All the ingredients required in muffins preparation (wheat flour, corn starch, eggs, sugar, milk, baking soda, salt, emulsifier and 65% fat butter) are mixed together and watermelon rind paste is added in it with different concentrations and baked at 180 °C for 25 minutes. Finally, muffins were undergone sensory evaluation and following conclusions had drawn. Firstly, the formulated product showed higher value of water activity than control. Slight increase in the mineral composition was also observed and the overall appearance was enhanced due to incorporation of watermelon rind.

### ***Watermelon rind incorporated noodle***

In this study, water melon rind powder was used to replace wheat flour at the level of 50, 100 and 150g/kg of combinations for the preparation of noodles. Along with this other ingredient such as water, sodium chloride and kansui reagent were added in required amount to prepare a smooth dough and thus desired thickness of noodles were prepared. The final product of all the combination undergoes sensory evolution and watermelon rind-based noodles at 100g/kg level were the most acceptable with 6.33 score [22].

## **Other uses**

### ***Pectin Extraction***

Pectin, a soluble complex polysaccharide present in the cell wall of the plants. Pectin is made up of D-galacturonic acid linked by K-(1-4) glycosidic linkages [25]. Pectin was extracted from watermelon rind accordingly to the method given by Canteri-Schemin et al. [26]. Extracted pectin can be used as food additive in the preparation of various food products such as jams and jellies, in yoghurt as a stabilizer. Although, it is also used in the pharmaceutical industry, and aids in digestion and lowering cholesterol [27].

### ***ZnO Nanoparticles Biosynthesis***

A novel study was done to extract ZnO Nanoparticles using watermelon rind. The watermelon rind aqueous extract was prepared mixing watermelon rind powder in distilled water followed by boiling and filtered later. The Supernatant solution is considered as watermelon rind extract. This Extract helps to synthesize ZnO nanoparticles via a chemical method and characterized by HPLC. Due to the presence of Citrulline in large amount in rind results in the stabilization of ZnO nanoparticles. Later these ZnO nanoparticles used as nano-sorbent and antimicrobial agent. This

study concludes, biosynthesis of nanoparticles aids in waste water treatment and also helps to reduce agro-waste [28].

### ***Bulk forming laxative***

Bulk-forming laxatives, are used to pass stools more easily through the intestines [29] and are widely used to treat constipation. A novel method was conducted to produce less adverse effect bulk forming laxative using watermelon rind combining with pectin and isabgol [30]. Ten different combinations were formulated by wet granulation method and dough was prepared using water in required amount. Dough was pressing and granules were dried at 60°C for 12 hr. At last, better as compared with market sample, the bulk forming laxative prepared from WRP and isabgol were found to be better due to various properties. Thus, such innovative product from natural sources will minimize the side effects of others laxative.

### **Conclusion**

This study concludes that the most underutilized portion of watermelon, rind possess good efficiency to be utilized not only in food industry but also in another sector. According to the United Nations Food and Agriculture Organization (FAO), fruits and vegetable processing industry estimated that losses and waste is the highest among all types of foods, and may reach up to 60%. About 25% - 30% of by-products wastes among whole commodity group produce by the processing of fruits and vegetables industry. Out of the total annual production, one third of it is simply discarded in the form of rind and peel. Therefore, this review gathers attention towards more and more utilization of fruits and vegetables.

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