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Nutritional and Functional Quality of Rambutan Peel (*Nephelium lappaceum* L.) Powder

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ABSTRACT: The present study was conducted to determine the physio-chemical composition of Rambutan (*Nephelium lappaceum* L) peel powder. Plain dried and soak dried rambutan fruit peel powder was used for the study. The nutri-chemical profiling revealed, plain dried peel powder had higher concentration of carbohydrate (55.45g/100g), fat (10.20g/100g), iron (21.45ppm), Vitamin C (5.00mg/100g) and Potassium (9.40mg/100g). There was significant difference in the quantity of sodium in the developed peel powders, plain dried peel powder (5.00mg/100g) had higher level of sodium when compared to the soak-dried rambutan peel powder (1.50mg/100g). However, soak dried peel powder revealed better functional properties like water absorption index (7.05g/100g), solubility (5.25%) and TSS (3.00°B). However, this comprehensive examination will through light in understanding the benefits of integrating fruit peel powders in food & nutraceutical development, which in turn represents a sustainable strategy to minimize food waste. Further exploration could delve into assessing the bioavailability and health effects of these nutrients and bioactive compounds, as well as optimizing formulations to maximize the utilization of fruit peel powder in diverse culinary applications.

Keywords: Rambutan peel, nutrients, minerals, physical quality, TSS.

INTRODUCTION

Plants have consistently been the primary source of medicine for preventive and curative purposes since ancient times. Rambutan (*Nephellium lappaceum*) is a non-climacteric fruit, one of the most popular tropical fruits which belongs to the Spindaceae family and is indigenous to Southeast Asian tropical regions. The fruit appearances as an ovoid berry, hue ranging from yellow to orange-red or maroon. Edible aril is acidic-sweet, wrapped around the seed.

Interestingly, peels of some fruits and vegetable possess greater bioactivity than the edible portion, due to better antioxidants profile. This is true in the case of rambutan fruit as well. Phenolic acids and ellagitannins are the primary antioxidants that contribute to the functionality of rambutan peel (Thitilertdecha *et al.*, 2010; Palanisamy *et al.,* 2011).

The peel of the rambutan constitutes 40-45% of the entire fruit. Rambutan fruit peel, is mostly regarded as trash, even though it has splendid therapeutic properties. Processing of rambutan fruit could generate huge amount of agricultural waste. The health benefits of rambutan peel are closely tied to its nutri-chemical composition, particularly its high levels of nutrients and bioactive compounds. Research indicates that rambutan fruit, especially peel, contain nutrients and bioactive components, that possess numerous pharmaceutical benefits, which includes antibacterial, antioxidant, antidiabetic, anti-inflammatory, and antiproliferative characteristics.

According to Tabata *et al.* (2008) Nephelium lappaceum fruit peel extract contains flavonoids, phenolics, tannins, quercetin, geraniin, ethyl gallate, epigallocatechin 3-gallate (EGCG), which has an antihyperglycemic activity and is a powerful antioxidant. The content of flavonoids such as catechin, quercetin and EGCG, polyphenols andtannins, suspected that the mechanism of reduction in blood glucose levels in testing animals through the inhibition of glucose absorption, stimulates the release of insulin and indirectly through a mechanism of antioxidant processes.

According to Evans *et al.* (2002), Geraniin is an ellagitannic compound found in Nephelium lappaceum rind, it has been found to have antihypertensive effects. A study conducted by Okonogi *et al*. (2007), on the antioxidant activity of rambutan fruit peel and grape seed extract reveals that rambutan peel is more potent source of natural antioxidants, free radical scavenging activity and total phenolics contents when compared with commercially prepared grape seed extract.

An in-depth understanding of the physio-chemical composition of rambutan peel powder, aids into valorisation of agri-food wastes and by-products utilisation. Considering its nutritional and health benefits, there is a need to promote this fruit and its underutilised fruit parts for health and preventive medicine. However, systemic documentation of the nutrient composition and functional properties is lacking, thus profiling the physio-chemical nature of the parts of rambutan fruit would enlighten the health-conscious population, regarding the nutrient, therapeutic potential and value addition of rambutan peel. This comprehensive examination will provide valuable insights into maximizing the fruit peels benefits and applications. Furthermore, the valorization of agri-food wastes and by-products can enhance regional food security and promote sustainable food production.

MATERIAL AND METHODS

A. Collection of Rambutan fruits

Ripened red rambutan (*Nephelium lappaceum* L.) fruits were collected from organic farms of Kottayam and Thiruvananthapuram district of Kerala, India. The samples were bought when available (July-September) in their fresh state.

B. Development of Rambutan peel powder

Rambutan peel powder was developed using the peel of red rambutan fruit, initially peel was washed, cleaned and wiped to remove specks of dirt, then it was cut into small pieces and dried in thermo-statically controlled electric oven, at different suitable temperatures as mentioned in Table 1.The dried fruit peel was then pulverized and sieved to obtain fine powder. The peel powder was then sealed and stored in laminated aluminium pouches to maintain a dry environment.

Table 1: Treatments adopted for development of Rambutan Peel Powder.

Sr. No.	Treatments
1.	Drying (T_1) - Dried at 40°C for 48 hrs, until the moisture is below 5 percent.
2.	Soaking (T_2) - Soaked for 6 hours in water and dried at 60°C for 48 hrs, until the moisture is below 5 percent.

Assessment of nutrients. Carbohydrate content in the dried rambutan peel powder was estimated using Anthrone method developed by Hedge and Hofreiter, (1962). Protein content was determined using a semi-automatic KjelTRON, following slight modifications in AOAC (2005). The fat was determined using modified Batch Solvent Extraction method (Min and Steenson 1998) using hexane as solvent. The procedure outlined by Rahul *et al.* (2010) was adopted for the estimation of crude fiber. The determination of vitamin C content was done with 2,6-dichlorophenolindo phenoltitration method, as outlined by Sadasivam and Manikkam (2008).

Iron content of the sample was determinedby Atomic Absorption Spectrometry (AAS) method, using the diacid extract prepared from sample (Page *et al*., 1992). Sodium and potassium content of the sample was determined using flame photometry method. The standard and sample solutions were aspirated into the flame photometer and the stable values in the display were recorded. Deionised water was taken as blank (AOAC, 1990).

Assessment of Physical attributes. The physical attributes or functional quality of the developed peel powders were analyzed. Physical properties describe the behavior of ingredients during preparation, cooking, storage and they also affect the finished products in terms of their appearance, flavour, texture, and taste.

Water absorption index. To ascertain the Water absorption index**,** specified volume of rambutan peel powder was taken in a centrifuge tube and combined with 10 ml of distilled water. The resulting suspension was left at room temperature and subjected to centrifugation. The measurements were taken for volume of water drained and sediment (Beuchat, 1977).

$$\text{Water absorption index} = \frac{\text{Wt. of water absorbed(g)}}{\text{Wt. of dried sample (g)}}$$

Swelling power. A specified quantity of rambutan peel powder was added to 10ml of distilled water and subjected to heating (80ºC).

After this process, the mixture was centrifuged, and weight of the resulting paste was measured once the supernatant had been poured off (Leach *et al.,* 1959). The formula applied to determine the swelling power was as follows:

$$\text{Swelling power} = \frac{\text{Wt. of paste (g)}}{\text{Wt. of the dry sample (g)}}$$

Percentage solubility. A known volume of rambutan peel powder was combined with 10 ml of distilled water and subjected to heating (80ºC). After the process, the resulting mixture was centrifuged, and the supernatant was carefully transferred into a weighed petri dish. This supernatant was then evaporated and subsequently weighed. The residue remaining after the supernatant had been dried represented the amount of powder that had been dissolved in the water (Oladele and Aina 2011).

$$\text{Solubility \%} = \frac{\text{Wt. of dried sample in the supernatant}}{\text{Wt. of original sample}} \times 100$$

Total Soluble Solids (TSS). Total Soluble Solids was ascertained using a digital pocket refractometer (ATAGO Pocket Refractometer) and is expressed in Degrees Brix (°B).

RESULTS AND DISCUSSION

This study was conducted to understand the physio-chemical composition of rambutan peel powder. Fruit peel, also referred to as rind or skin, serves multiple functions, it acts as a protective barrier, shielding the inner flesh from physical damage, microbial attack, and dehydration. Moreover, fruit peel often contains essential nutrients, phytochemicals, flavor compounds, and dietary fiber. Table 2. depicts the nutrient composition of plain-dried and soak-dried rambutan peel powder.

Table 2: Nutrients in Rambutan peel powder.

Nutrients	T_1	T_2	t value	P value
Carbohydrate (g/100g)	55.45	21.96	20.388	0.00*
Protein (g/100g)	5.25	6.10	-3.228	0.009*
Fat (g/100g)	10.20	10.10	0.685	0.509
Crude fiber (g/100g)	0.068	0.077	-8.714	6e-06*
Vitamin C (mg/100g)	5.00	4.87	0.687	0.5074
Iron (ppm)	21.45	17.61	13.192	0.00*
Sodium (mg/100g)	5	1.50	0.808	0.4381*
Potassium (mg/100g)	9.40	8.50	9.668	2e-06*

(Results are expressed as mean values of six replicates)*Significant at 5% level
T_1 – Plain dried peel powder T_2 – Soak-dried peel powder

According to Afzaal *et al.* (2023) dried peels of rambutan contained 3-4 times higher quantity of fat and protein when compared to the fresh rambutan peel. In the present study, **plain dried rambutan peel powder (T_1) had shown higher** (55.45g/100g) **carbohydrate content than soak-dried peel powder (T_2). Protein content was found to be slightly higher (6.10g/100g) in soak-dried peel powder than plain dried powder (5.25g/100g).** No significant difference was observed in the fat content in both plain-dried (10.20g/100g) and soak-dried (10.10g/100g) rambutan peel powders. Crude fiber content was found to be similar in both plain dried (0.068g/100g) and soak-dried (0.077g/100g) rambutan peel powders as shown in Fig. 1. Afzaal *et al.* (2023) reported fresh rambutan peel contain 22.73g/100g carbohydrate, 1.95g/100g protein, 0.24g/100g fat and 0.65g/100g fiber.

Sorada *et al.* (2015). Studied the fat content of various fruit peels and reported that Longong peel, Santol peel and Chok Anan mango peel had the highest fat contents of12.01g/100g, 4.09g/100g and 3.36g/100g respectively. Moreover, Durain and Rambutan peel exhibited lower concentration fat as 0.82g/100g and 0.89g/100g respectively.

Johnson *et al.* (2013) reported that concentration of Vitamin C in fresh and dried rambutan peel as 7.43mg/100g and 5.12mg/100g respectively, which is similar to the vitamin C levels obtained in the present study. Moreover, Thitilertdecha *et al.* (2010) reports that vitamin content of dried rambutan peel was lower than that of fresh peel, this may be due to the heat labile nature of vitamins, when subjected to heat at at 55°C for 24 h. However, in the present study, no significant difference was recorded in Vitamin C content of plain dried peel (5.00mg/100g) and the soak dried rambutan peel powder (4.87mg/100g).

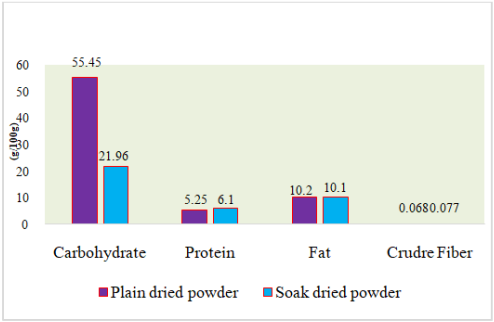

Fig. 1. Nutrients in rambutan peel powder -1.

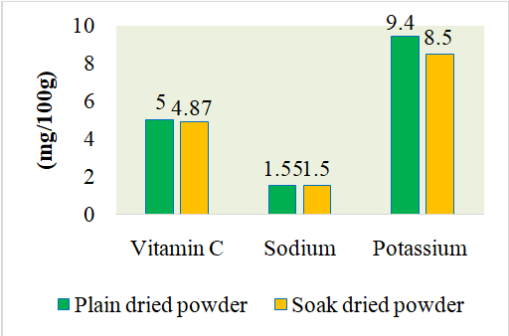

Fig 2. Nutrients in rambutan peel powder -2.

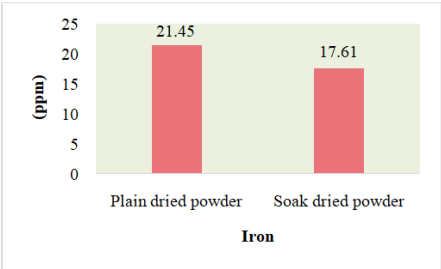

Fig. 3. Nutrients (Iron) in Rambutan peel powder -3.

Table 3: Physical properties of developed peel powder.

Physical qualities	T_1	T_2	t value	P value
Water absorption index (g/100g)	6.25	7.05	-2.485	0.032*
Swelling power (g/100g)	5.40	4.68	6.067	0.00*
Percentage solubility (%)	4.15	5.25	-11.69	0.00*
Total Soluble solids(°B)	2.80	3.00	-1.142	0.280

(Results are expressed as mean values of six replicates)*Significant at 5% level; T_1 – Plain dried peel powder T_2 – Soak-dried peel powder

Water absorption index is the capability of a moist material to absorb water when exposed to an external centrifugal gravity force. In the present study, soak dried peel powder (7.05g/100g) expressed higher water absorption index than plain dried peel powder (6.25g/100g). Plain dried rambutan peel powder (5.40g/100g) showed significantly higher Swelling power, when compared to soak dried peel powder (4.68g/100g) as depicted in Fig. 4.

Sorada *et al.* (2015) studied the functional properties of various fruit peels. Water holding capacity and oil holding capacity were analysed and recorded. The highest water holding capacity was exhibited by Durian peel (11.14g water/g fiber) and Longong peel (7.18g water/g fiber). Subsequently low water holding capacity was expressed by rambutan peel (4.87 g water/g fiber), which is lower than the water holding capacity obtained in the present study. However, Durian peel (3.02g oil/ g fiber) and Longong peel (2.27 g oil/ g fiber) showed higher oil holding capacity. Rambutan peel had possessed low oil holding capacity of (1.75g oil/ g fiber).

Fig. 5 represents the Percentage solubility of the developed rambutan peel powders. Soak dried rambutan peel powder (5.25%) showed higher solubility than plain dried rambutan peel powder (4.68%). According to Siol *et al.* (2022). the percentage of Water solubility of rambutan seed powders were ascribed as 9.50% and 11.20% for conventionally dried and freeze-dried rambutan seed powder respectively.

No significant difference was observed in the Total soluble solid (TSS) content in both rambutan peel powders. Soak dried peel powder (3.0°B) expressed higher degree of TSS, than the plain dried peel powder (2.8°B) as shown in Fig. 6. According to Paul *et al.* (1984). TSS content of fruits vary in accordance with the maturity and cultivar, it ranges from 17 to 211°Brix for rambutans, 16 to 251°Brix for longans and 13 to 201°Brix for lychees.

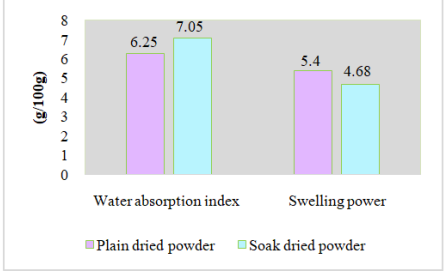

Fig. 4. Water absorption and Swelling power of rambutan peel powder.

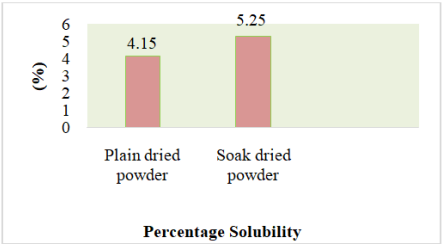

Fig. 5. Percentage solubility of Rambutan peel powders.

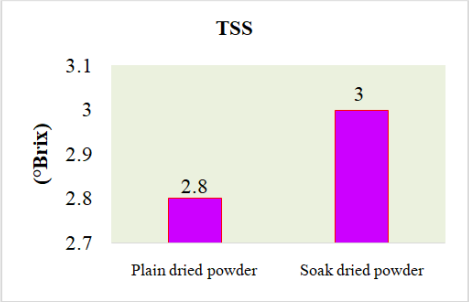

Fig. 6. Total soluble solids of Rambutan peel powders.

CONCLUSIONS

Rambutan peel powder could be considered as a potential source of natural functional ingredient in food product development. Moreover, it helps in improving the functionality of food products, via means to improve the phyto-therapeutic potential. In this study, rambutan peel has reported to have wide range of nutrients especially, carbohydrate, protein, fat, vitamin C, iron and potassium.

Moreover, rambutan peel powder possessed good functional properties, which pay way to value addition and incorporation of rambutan fruit by-products in food industry. This comprehensive examination will provide valuable insights into maximizing the fruit peels benefits and applications. Furthermore, the valorisation of agri-food wastes and by-products can enhance regional food security and promote sustainable food production.

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Conflict of interest. None.

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