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NUTRITIONAL AND PHYTOCHEMICAL PROFILING OF FOODS FORMULATED WITH DRAGONFRUIT AND BEETROOT PEEL POWDER

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Abstract

Products from bakeries and cereal companies play a significant role in modern consumers' diets. A cursory glance at the shelves of grocery stores conveys the impression of a wide selection of baked goods. Wafers have been made and used by the food business for many years, with very few adjustments, due to its low weight, flat construction, and delicate crispy texture. A cookie, often called a biscuit, is a little, sweet, baked treat or snack. Current research is focused on recovering bioactive or functional components from vegetable and fruit wastes, not only to reduce waste disposal but also to satisfy public demand for plant-based goods that are helpful to health. Peel from beetroot and dragon fruit is a by-product of processing at household and industrial levels. Pectin, phenols, antioxidants, betacyanin coloring, and total dietary fiber can all be found in good amounts in dragon fruit peel. Antioxidant components found in beetroot peel suggest its potential applications in the food and nutritional supplement industries. Three different wafer roll formulations were created by combining wheat flour with dragon fruit peel powder in percentages of 25%, 50%, and 75% as well as three different cookie formulations were created by combining wheat flour with beetroot peel powder in percentages of 25%, 50%, and 75%. The food formulations from peel powders were found to be highly palatable holding numerous nutrients and phytonutrients.

Keywords: Beetroot peel; Cookie; Dragonfruit peel; Wafer.

Introduction

The organic fraction of food and kitchen waste is mostly made up of inorganic components as well as proteins, fats, carbs, and lipids. Food wastes heterogeneity, high moisture content, and poor calorific value present the most conversion challenges. Depending

on the source, food wastes have different compositions. Therefore, not all food wastes can benefit from the same approach. Depending on the composition and source, a treatment may be applied to facilitate the development of microorganisms and create the desired output in an economical and environmentally responsible manner [1].

One of the main issues that most food processing facilities deal with is waste disposal. The conventional method of using trash for agriculture is no longer a practical option because of significant modifications to agricultural methods and regulations regarding pollution. Additionally, the valuation of waste is becoming more and more intriguing due to recent advancements in process engineering and the byproducts that arise from them [2].

Because the disposal of food processing wastes has a detrimental influence on the environment, it has long been thought that these wastes should be treated, reduced, and prevented. Many food wastes have been found to be an excellent source of nutraceuticals [3]. The potential to separate nutraceuticals from agricultural byproducts is made possible by the development of techniques that permit both their recovery and application in food compositions [4].

Side streams and by-products like peels and seeds collected from fruit and vegetable processing factories could be a potential source of phytochemicals and antioxidants (especially phenolic compounds) in light of the circular economy and minimizing food wastes [5]. Kitchen and food wastes can be turned into a variety of products with additional value. These include films, high fructose syrup, levulinic acid, mushrooms, nutraceuticals, organic acids, pigments, single cell protein, sugars, vermicompost, xanthan gum, activated carbon adsorbent, antioxidants, bioactive, bioethanol, biobutanol, biodiesel, biogas, bioelectricity, biopolymer, bio nanocomposite, chitosan, corrosion inhibitors, DHA, and industrial enzymes [1].

Products from bakeries and cereal companies play a significant role in modern consumers' diets. A cursory glance at the shelves of grocery stores conveys the impression of an extensive variety of baked goods. Breads come in a variety of forms, including multigrain breads, croissants, pitas, and conventional white pan bread. From the freezer to the fridge to the shelves, there are countless varieties of cookies, pastries, and confections to be discovered [6]. Bakery goods have a significant part in human nutrition and are often consumed in enormous quantities. Beyond their basic nutritional role, functional substances have gained

popularity in bread products because of their potential to lower the risk of long-term health conditions [7].

Flute wafers are crisp, multilayered wafers made from an infinite, thin sugar wafer band wrapped into a flute form. They are additionally referred to as wafer sticks, roll wafers, or wafer curls. The structure of the thin, glassy layers giving these long, thin wagers their distinctive, delicate and crisp texture is one of their characteristics. With the highest sugar proportion, flute wafers are classified as high sugar wafers. The majority of items have coatings or cream inside. The infinite wafer band method yields fan wafers, which are crushed or folded into flat portions. Additionally, they can be shaped into wafer pralines [8].

Cookies are any of several small sweet cakes, either flat or slightly elevated, cut from rolled dough, dropped from a spoon, chopped into pieces after baking, or curled with a special iron. The word comes from the Dutch word koekje, which is a diminutive of koek, "cake." These are mostly consumed in the United States. In Scotland, a little, basic bun is referred to as a cookie. Cookie recipes differ greatly from one another. Cookies made with a basic dough of flour, butter, sugar, and egg are likely the most well-liked in the US. A range of flavoring and texturizing ingredients, such chocolate chips, oatmeal, raisins, or peanut butter, can be added to this dough. The size of sugar grains significantly affects cookie texture, affecting spread and expansion during baking. This impact is partially due to conflict between the flour's gluten and the sugar's slow-dissolving water content. After baking, cookies—aside from soft varieties—usually have a moisture level of less than 5%, giving them a crisp texture and exceptional stability during storage [9].

The dragon fruit, a super fruit that has just lately been brought to India, is regarded as a fruit crop with great potential for profitability. Fruit comes originally from Mexico and Central and South America, and its beautiful colour and smooth, melting flesh with edible black seeds embedded in it, combined with its exceptional nutritional value, draw gardeners from all over India to plant this fruit crop [10, 11,12].

Typically, dragon fruits are eaten raw or turned into juice. The fruit has between 36.70 and 37.60 percent peel, which is typically thrown away during processing, particularly in the beverage processing industries where it could have negative environmental effects. Peels are an excellent source of pectin, phenols, antioxidants, betacyanin pigment, and all of the dietary fiber; therefore, they must be processed into easily handled goods that have a longer shelf life. It can also be used to extract pigments from peels and incorporate those

colors into other goods to improve their functionality. When peels were sprayed rather than drum dried, more of the red color was retained [13].

The peel of beetroot, which is a by-product of processing beetroots, is a vital source of health-promoting bioactive compounds [5]. Antioxidant components found in beetroot peel suggest its potential applications in the food and dietary supplement industries. Beetroot extracts, in particular the peel extracts, have demonstrated considerable antioxidant activity when compared to other vegetable peel extracts. Red beetroot's major beta-cyanine, betalines, is mostly found on the outside of the root and decreases in the peel, crown, and flesh sections. The peels have higher quantities of betaline and isobetaline than the beetroot tissue. Beetroot peel has the potential to be used as a nutraceutical since it can scavenge free radicals and suppress the growth of microorganisms [14].

Materials and methods

Material

The ingredients required for the development of dragon fruit peel powder incorporated value added wafer rolls like wheat flour, corn flour, dragon fruit, coconut oil, baking powder, powdered white sugar and also different ingredients for the development of value-added cookies like wheat flour, beetroot, sugar, butter were purchased and stored at room temperature until they were used.

Methods

The goal of the current investigation is to enable the use of fruit and vegetables wastes arising from the food industry in food formulations like wafer rolls and cookies ensuring the availability of potential nutrients and nutraceuticals.

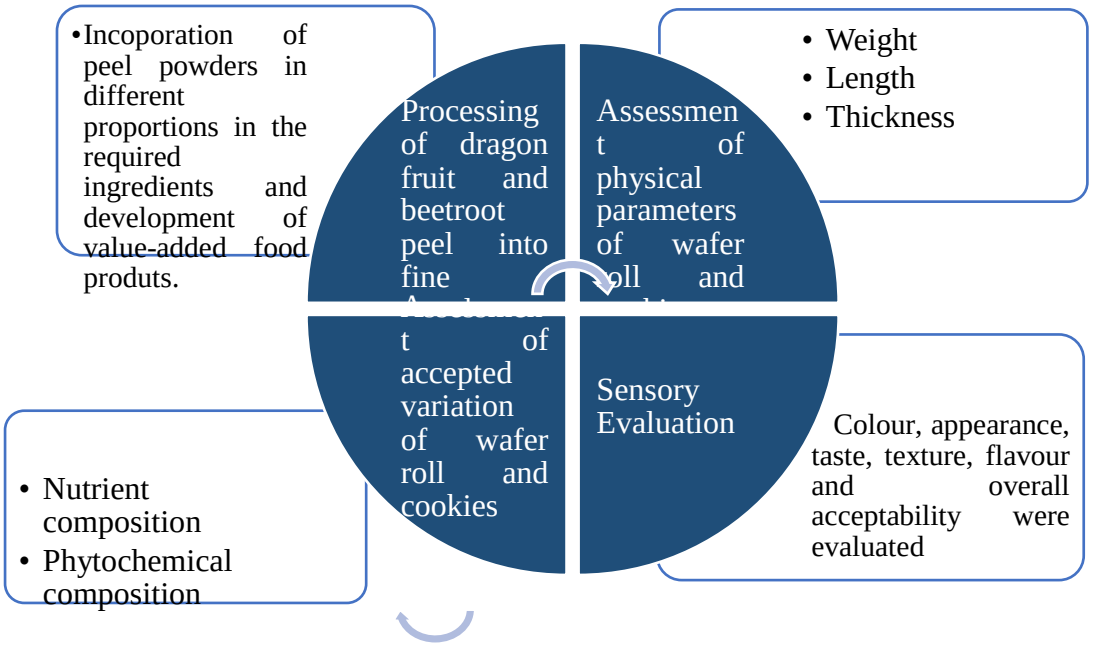


Figure 1: Formulation and evaluation of value-added foods from vegetable and fruit peel

Preparation of dragon fruit and beetroot peel powder

Dragon fruit peel was which was free from damage was purchased and made into powder as illustrated in figure 2. Similarly, after procurement, whole beetroot was checked for any infestation or damage present. Broken or infested beetroot were manually graded and removed. Good quality beetroot was cleaned by removing foreign matters and then washed with cold water several times to remove or eliminate bitter taste and toxins. Then separate the peel from the beetroot and allow the beetroot peel to dry for 3-4 days until the moisture in the peel were completely reduced and became brittle.

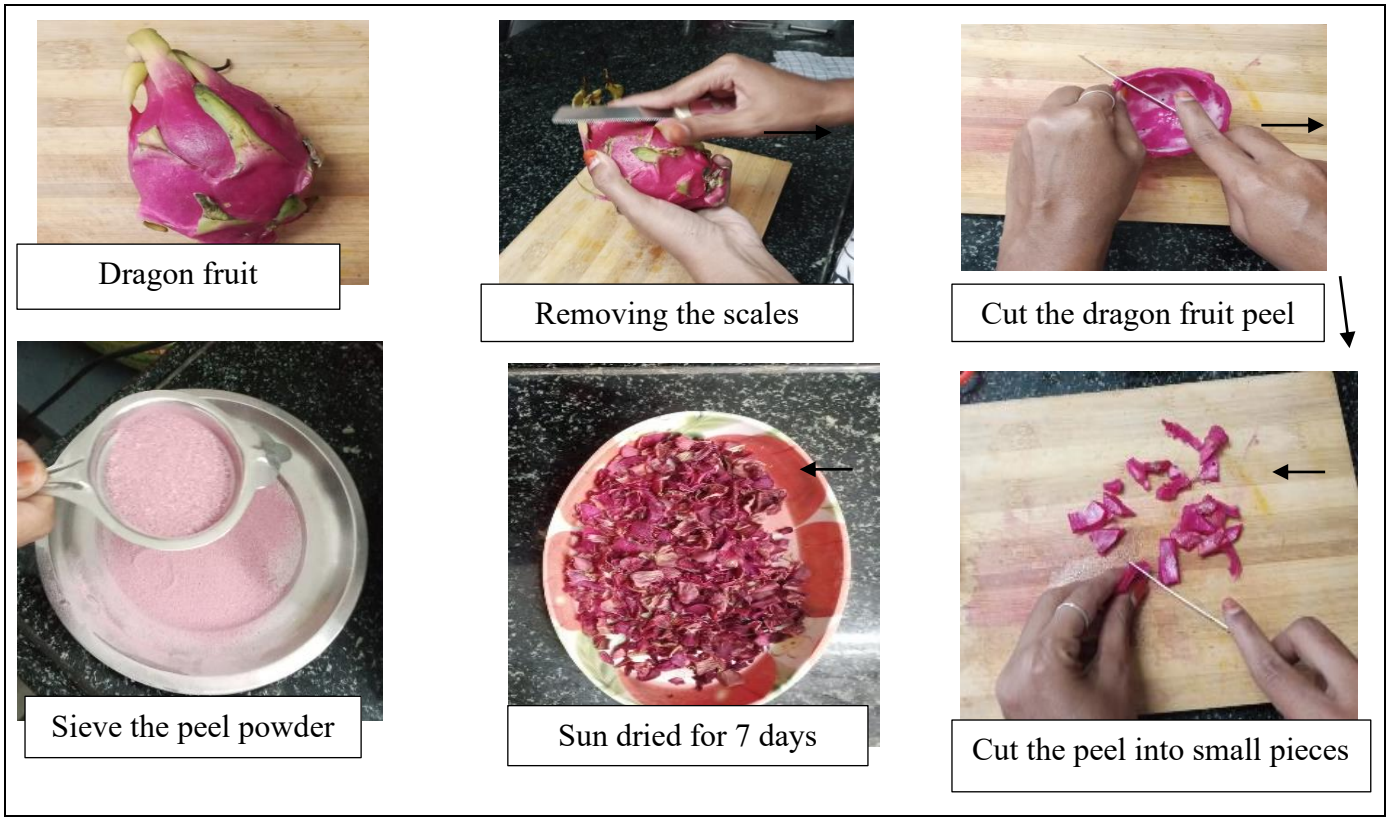


Figure 2: Preparation of dragon fruit peel powder

Formulation of dragon fruit peel powder incorporated wafer rolls

The ingredients in the ratio listed as in table-1 were mixed together to form a batter. A spoon of wafer batter was placed on the non- stick pan and spread evenly with the help of brush into a thin layer and cooked in low flame for 2 minutes. Flip now and then and after 2 minutes of cooking, roll the hot wafer sheet with the help of a roller. Place the wafer rolls on the preheated pan. Bake the wafer rolls for 4 – 6 minutes at 200^{o} C until it becomes crispy. Wafer rolls are ready to serve.

Table 1: The optimum quantity of ingredients for dragon fruit peel powder incorporated wafer rolls

Ingredients	**Level of incorporation**			
	Control	**DPPWR I**	**DPPWR II**	**DPPWR III**
Whole wheat flour(g)	100	75	50	25
Dragon fruit peel powder(g)	-	25	50	75
Corn Flour(tbs)	1	1	1	1
Powdered sugar(g)	40	40	40	40

Milk (ml)	30	30	30	30
Vanilla Extract(tsp)	1	1	1	1
Baking powder(tsp)	1	1	1	1
Salt(g)	1	1	1	1
Coconut Oil(ml)	4	4	4	4

DPPWR- Dragonfruit Peel Powder Wafer Roll

Formulation of beetroot peel powder incorporated cookies

For the formulation of different variations of the beetroot peel powder incorporated cookies, the different proportions of the beetroot peel powder (25g, 50g, 75g) were incorporated into wheat flour (75g, 50g, 25g) respectively along with the ingredients listed in table-2 to form a a soft dough. Leave the dough for 30 minutes at refrigerator temperature. After 30 minutes, cut the dough into desired shapes. Bake it in an oven at 200^{o} C for 10 minutes. Beetroot peel powder cookies are ready to serve.

Table 2: The optimum quantity of ingredients for beetroot peel powder incorporated cookies

Ingredients	Level of Incorporation			
	Control	BPPC I	BPPC II	BPPC III
Beetroot Peel Powder (g)	-	25	50	75
Wheat flour (g)	100	75	50	25
Butter (g)	10	10	10	10
Brown sugar (g)	25	25	25	25

BPPC- Beetroot Peel Powder Cookies

Figure 3: Variations of dragonfruit peel powder wafer rolls and beetroot peel powder cookies

Results and Discussion

Physical parameters

The physical parameters of the developed variations of wafer rolls and cookies were evaluated. The parameters such as height, weight, and thickness were studied and the results are presented in the table 3.

Table 3: Physical parameters of control and developed variations

Physical parameters	Developed variations of dragon fruit peel powder incorporated wafer rolls			Developed variations of beetroot peel powder incorporated cookies		
	DPPWR I	DPPWR II	DPPWR III	BPPC I	BPPC II	BPPC III
Height(cm)	13±0.35	13.6±0.05	13.2±0.15	4.5±0.15	4.5±0.15	4.4±0.15
Weight(g)	11±0.30	11.7±0.25	11.8±0.1	7.2±0.2	7.2±0.25	7.2±0.25
Thickness(cm)	3.7±0.1	3.7±0.2	4±0.1	1.6±0.1	1.3±0.15	1.3±0.15

It is predicted from the above table that the height of the control wafer rolls was found to be 12.3 cm whereas the height of DPPWR I, DPPWR II, and DPPWR III wafer rolls was found to be 13 cm, 13.6 cm and 13.2 cm. The wafer prepared from oats flour, rye flour, corn flour and barley flour have the height of 16.5 cm as mentioned in the study [15.] The weight of the control wafer rolls was found to be 10.6g whereas the weight DPPWR I, DPPWR II, and DPPWR III wafer rolls was found to be 11 g, 11.7 g and 11.8 g. The thickness of the control wafer rolls was found to be 3.5 cm whereas the thickness of DPPWR I, DPPWR II, and DPPWR III wafer rolls was found to be 3.7 cm, 3.7 cm and 4cm.

The height of the developed variation of cookies was 4.5±0.15cm, 4.5±0.15cm and 4.4±0.15cm for BPPC-I, BPPC -II and BPPC -III respectively. The weight of the variations of cookies was 7.2±0.2g, 7.2±0.25g, 7.2±0.25g for BPPC-I, BPPC -II and BPPC -III respectively. In the study by Shafi et al. (2022)[16], the weight of the banana peel flour incorporated cookies was found to be 8.87–12.49 g which was higher than the developed variation of cookies whereas the diameter of the banana peel flour incorporated cookies varied from 4.067cm to 4.167 cm which was slightly similar to the developed variation of cookies.

The thickness of the developed variations of cookies was 1.6±0.1cm, 1.3±0.15cm and 1.3±0.15cm for BPPC-I, BPPC -II and BPPC -III respectively. It was found in literature

that the thickness of the pomegranate peel powder incorporated cookies was 1.36 cm which was similar to the developed variations of cookies[17].

Sensory evaluation

The sensory evaluation of the developed variations of wafer rolls and cookies were performed by totally 30 semi-trained respondents considering different parameters like appearance, colour, taste, texture, flavour and overall acceptability. Nine-point hedonic rating scale method was adopted to estimate the acceptance of the developed products. Results of ANOVA Duncan multiple range tests showed that there was a significant difference ($p \leq 0.05$) between the control and all the variations of the wafer roll and cookies as depicted in table-4 and figure 5.

Table 4: Statistical analysis of mean organoleptic values of control and developed variations of wafer rolls and cookies

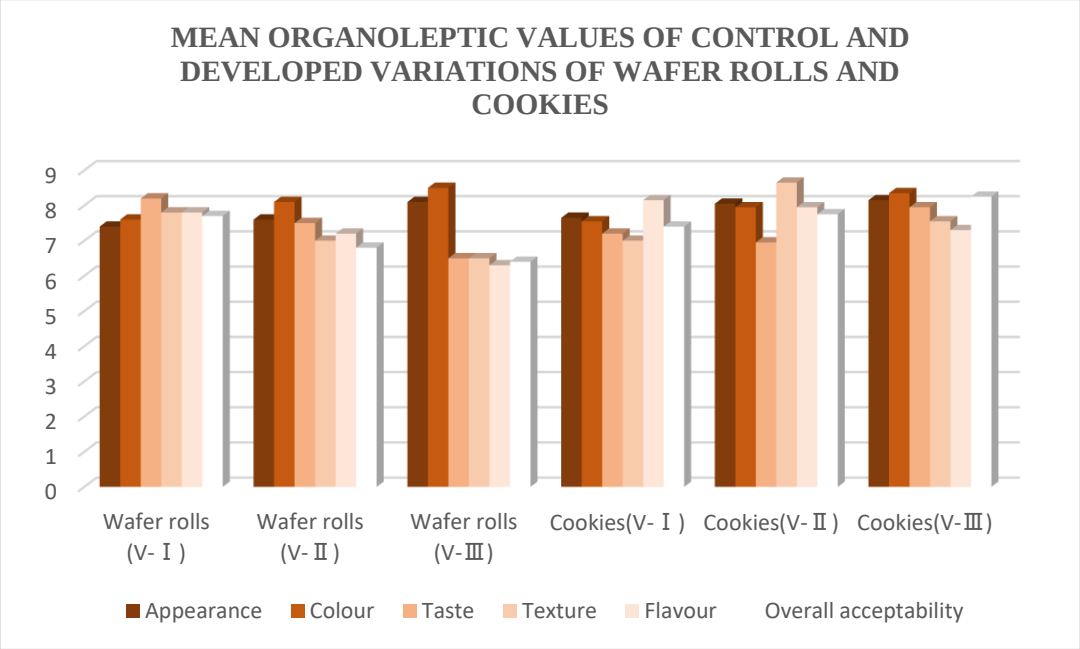
Parameters	Dragon fruit peel powder incorporated wafer rolls				Beetroot peel powder incorporated cookies			
	DPPWR I	DPPWR II	DPPWR III	Significance	BPPC I	BPPC II	BPPC III	Significance
Appearance	7.40 ± 1.14^{ab}	7.65 ± 0.59^{bc}	8.15 ± 0.67^{c}	0.00*	7.65 ± 0.74^{b}	8.05 ± 0.76^{bc}	8.15 ± 0.59^{c}	0.00*
Colour	7.60 ± 0.53^{b}	8.15 ± 0.37^{c}	8.55 ± 0.51^{d}	0.00*	7.55 ± 0.89^{b}	7.95 ± 0.60^{bc}	8.35 ± 0.59^{c}	0.00*
Texture	8.25 ± 0.55^{c}	7.50 ± 0.51^{b}	6.55 ± 0.69^{a}	0.00*	7.20 ± 0.89^{a}	6.95 ± 0.89^{a}	7.95 ± 0.94^{c}	0.00*
Taste	7.80 ± 0.69^{c}	7.05 ± 0.69^{b}	6.50 ± 0.51^{a}	0.00*	7.00 ± 1.33^{a}	8.65 ± 0.49^{c}	7.55 ± 0.94^{ab}	0.00*
Flavour	7.80 ± 0.69^{c}	7.25 ± 0.64^{b}	6.35 ± 0.49^{a}	0.00*	8.15 ± 0.74^{c}	7.95 ± 0.89^{c}	7.30 ± 0.92^{a}	0.01*
Overall acceptability	7.75 ± 0.79^{b}	6.85 ± 0.6^{a}	6.40 ± 0.50^{a}	0.00*	7.40 ± 0.75^{a}	7.75 ± 0.97^{ab}	8.25 ± 0.72^{c}	0.01*

*Significant at 5% level. Values are expressed as mean $\pm$ standard deviation. Samples with different superscripts within a column are significantly different from one another at($p \leq 0.05$).

Sensory score of dragon fruit peel powder incorporated wafer rolls for different characteristics such as appearance was 8.15 in DPPWR III which was greater than control and other variations, the colour of DPPWR III was 8.55 which was higher than control and other variations, the texture of DPPWR I scored 8.25 which was greater than developed variations, the taste of DPPWR I with score 7.80 was higher than all other developed variations, the flavour of DPPWR I was 7.80 which was greater than all other developed variations and overall acceptability with 7.75 of DPPWR I was highest of all other developed variations. Based on the sensory evaluation of the developed wafer rolls, DPPWR I (25%

dragonfruit peel powder incorporated wafer rolls) was more acceptable. Hence further analysis of nutrients and phytochemicals were done for DPPWR I.

Similarly, the sensory score of beetroot peel powder incorporated cookies for different characteristics such as appearance was 8.15 in BPPC III which has greater than control and other variations, the colour of BPPC III was 8.35 which was greater than control and other developed variations. The taste of BPPC III was 7.95 which was greater than developed variations, the texture of BPPC II was 8.65 which was higher than all other developed variations, the flavour of BPPC I was 8.15 which was greater than the other variations and the overall acceptability with 8.25 score BPPC III were the highest of all other developed variations. Based on the sensory evaluation of the developed cookies, BPPC III (75% beetroot peel powder incorporated cookies) was more acceptable. Hence further analysis of nutrients and phytochemicals were done for BPPC III.



Nutrient and Phytonutrient analysis of the accepted variation of wafer rolls and cookies

The nutritive value of accepted variation of wafer and cookies were assessed. The nutrient assessed includes energy, carbohydrates, protein, fat, dietary fibre, ash, potassium, calcium, magnesium, manganese, vitamin C, iron, copper and phosphorous.

Table 5: Nutrients in the accepted variation of wafer rolls and cookies

S. No	Nutrients	Accepted variation of dragon fruit peel powder incorporated wafer rolls (DPPWR-I)	Accepted variation of beetroot peel powder incorporated cookies

			(BPPC-III)
1	Energy (Kcal/100g)	364	434
2	Protein(g/100g)	10.6	12.6
3	Fat(g/100g)	2.8	18.2
4	Carbohydrates(g/100g)	74	55.0
5	Dietary Fibre (g/100g)	4.2	6.4
6	Ash(g/100g)	1.5	2.1
7	Potassium(mg/100gm)	591	310
8	Calcium(mg/100gm)	116	NA
9	Magnesium(mg/100gm)	72	NA
10	Manganese(mg/100gm)	1.3	NA
11	Vitamin C(mg/100gm)	5.4	NA
12	Iron (mg/100g)	NA	8.7
13	Copper (mg/100g)	NA	0.5
14	Phosphorous (mg/100g)	NA	116

NA- Not analysed

In a 100 gram of wafer rolls, the energy was found to be 364kcal whereas in a 100 gram of cookies, the energy was found to be 434kcal. The protein content of accepted variation of wafer rolls was 10.6g while the protein content developed cookies was 12.6g. In this study, the fat content was found to be 2.8g in wafer rolls and 18.2g in cookies as it is made of butter. The carbohydrate present in the wafer rolls was 74g and in the cookies was 55g.

The potassium content was found to be 591mg/100g in developed wafer rolls and 310mg/100g in developed cookies. In wafer rolls, there was 116mg of calcium, 72mg of magnesium, 1.3mg of manganese and 5.4mg of vitamin-C.

In 100gms of 75% beetroot peel powder incorporated cookies, 434 kcal of energy, 55.0g of carbohydrates, 12.6g of protein, 18.2g of fat, 6.4g of dietary fibre, 2.1g of ash, 8.7mg of iron, 0.5mg of copper, 116mg of phosphorous and 310mg of potassium were found to be present. It was found that except fat all the other nutrients were present in higher quantities in this value added cookies compared to control cookies found in astudy[18.]

Table 6: Phytochemicals in accepted variation of wafer rolls

S. No	**Parameters**	**Results**

1.	Betacyanin	Present
2.	Flavonoids	Present
3.	Phenolic content – Gallic acid	Present
4.	Pectin	Present

The phytochemicals present in the accepted variation are betacyanin, phenolic acid – Gallic acid, flavonoids and pectin.

Table 7: Phytochemicals in accepted variation of cookies

S. No	Qualitative Analysis	Present / Absent
1	Betalains	Present
2	Flavonoids	Present
3	Polyphenols	Present
4	Saponins	Present
5	In-organic Nitrate	Present

The above table 7 shows that the accepted variation of beetroot peel powder incorporated cookies contains betalains, flavonoids, polyphenols, saponins and in-organic nitrate.

Betalains possess antimicrobial, anticancer, hepatoprotective, neuroprotective, and anti-inflammatory properties. Flavonoids are indispensable component in a variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications owing to its broad-spectrum health-promoting effects. Gut microbes alter polyphenols to bioactive compounds that showcase therapeutic effects. Various studies suggest that the consumption of saponins has positive effects if consumed within the safe limits, for instance 1–1.2% saponins in diet is responsible for reducing the liver cholesterol and plasma in rabbits.

Conclusion

Dragon fruit peel powder and beetroot peel powder has several health benefits including antioxidants properties so it is recommended for the people suffering from non-communicable disease. When compare to all varieties of dragon fruit, red dragon fruit peel has efficient nutraceutical properties as well as other nutrients, so it is better to use red dragon fruit peel for numerous health benefits. As dragon fruit peel and beetroot peel have demonstrated their potential as promising bioactive antioxidants, they may be potential source of functional food ingredients and nutraceuticals that can be used in various areas of

food industries. From the nutrient point of view, the dragon fruit peel powder incorporated wafer rolls and beetroot peel powder incorporated cookies were found to high in dietary fibre, iron, copper, potassium and phytochemicals. Hence, these products are nutrient rich and it will be suitable for all age groups.

References

1. Sindhu, R., Gnansounou, E., Rebello, S., Binod, P., Varjani, S., Thakur, I. S., ... & Pandey, A. (2019). Conversion of food and kitchen waste to value-added products. *Journal of environmental management*, *241*, 619-630.
2. Oreopoulou, V., & Tzia, C. (2007). Utilization of plant by-products for the recovery of proteins, dietary fibers, antioxidants, and colorants. In *Utilization of by-products and treatment of waste in the food industry* (pp. 209-232). Boston, MA: Springer US.
3. Schieber, A., Stintzing, F. C., & Carle, R. (2001). By-products of plant food processing as a source of functional compounds—recent developments. *Trends in food science & technology*, *12*(11), 401-413.
4. Galanakis, C. M. (2012). Recovery of high added-value components from food wastes: Conventional, emerging technologies and commercialized applications. *Trends in Food Science & Technology*, *26*(2), 68-87.
5. Lazar, S., Constantin, O. E., Horincar, G., Andronoiu, D. G., Stănciuc, N., Muresan, C., & Râpeanu, G. (2022). Beetroot by-product as a functional ingredient for obtaining value-added mayonnaise. *Processes*, *10*(2), 227.
6. Smith, J. P., Daifas, D. P., El-Khoury, W., Koukoutsis, J., & El-Khoury, A. (2004). Shelf life and safety concerns of bakery products—a review. *Critical reviews in food science and nutrition*, *44*(1), 19-55.
7. Martins, Z. E., Pinho, O., & Ferreira, I. M. P. L. V. O. (2017). Food industry by-products used as functional ingredients of bakery products. *Trends in Food Science & Technology*, *67*, 106-128.
8. Tiefenbacher, K. F. (2018). *The technology of wafers and waffles II: recipes, product development and know-how*. Academic Press.
9. Britannica, T. Editors of Encyclopaedia 2024, February 1, cookie, Encyclopedia Britannica, https://www.britannica.com/topic/cookie-food
10. Britton, N. L., & Rose, J. N. (1963). *The Cactaceae: descriptions and illustrations of plants of the cactus family* (Vol. 3). Courier Corporation.
11. Morton, J. F. (1987). *Fruits of warm climates*. JF Morton.

12. Mizrahi, Y., & Nerd, A. (1996). New crops as a possible solution for the troubled Israeli export market. In *Progress in new crops: Proceedings of the Third National Symposium, Indianapolis, Indiana, USA, 22-25 October, 1996.* (pp. 37-45). American Society for Horticultural Science.
13. Bakar, J., Ee, S. C., Muhammad, K., Hashim, D. M., & Adzahan, N. (2013). Spray-drying optimization for red pitaya peel (Hylocereus polyrhizus). *Food and Bioprocess Technology*, *6*, 1332-1342.
14. Kujala, T. S., Vienola, M. S., Klika, K. D., Loponen, J. M., & Pihlaja, K. (2002). Betalain and phenolic compositions of four beetroot (Beta vulgaris) cultivars. *European Food Research and Technology*, *214*, 505-510.
15. Nasabi, Mahshad. Physical, structural and sensory properties of wafer batter and wafer sheets influenced by various sources of grains. LWT 149 (2021): 111826.
16. Shafi, A., Ahmad, F., & Mohammad, Z. H. 2022. Effect of the addition of banana peel flour on the shelf life and antioxidant properties of cookies. ACS Food Science & Technology, 2(8), 1355-1363.
17. Ranjitha, J., Bhuvaneshwari, G., & Jagadeesh, S. L., 2018, Effect of different treatments on quality of nutri-enriched cookies fortified with pomegranate peel powder and defatted soybean flour. Int. J. Curr. Microbiol. App. Sci, 7(2), 3680-3688.
18. Singh R., Arivuchudar.R. "Formulation and evaluation of peanut flour incorporated cookies". International Journal of Food Science and Nutrition, Volume 3, Issue 5, 2018, Pages 56-59