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INCREASING THE CONTENT OF FIBER AND MINERALS IN GNOCCHI WITH ADDED DRAGON FRUIT PEELS AS SUBSTITUTION OF INGREDIENT FOR IMPROVEMENT OF FOOD PRODUCT QUALITY AND HUMAN HEALTH

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KEY WORDS:
Hylocereus undatus, nutrition, pasta, zero hunger

ABSTRACT

Gnocchi is a type of homemade pasta made from potatoes, flour and eggs. Improving food product quality in terms of nutrition in gnocchi products it is possible now also use food waste. In addition to improvement of food product quality and human health, the addition of dragon fruit peel, which is considered as waste, can provide reasonable solutions or ideas about recycling of food waste. In this study, the produced food product was gnocchi with addition of by-product — dragon fruit peel, which was tested for fiber content and content of the following minerals: iron, potassium, calcium. The data obtained were then analyzed statistically by the SPSS program to determine the effect of variation using the T-test. Based on the results of the study it was concluded that the content of dietary fiber of dragon fruit peel in the sample of gnocchi denoted as F3 featured the highest water-soluble dietary fiber content with a score of 1.33%, water insoluble dietary fiber content with a score of 1.86%. and total dietary fiber content with a score of 3.19%. This also shows that the more dragon fruit peel is added, the higher is the total dietary fiber content in gnocchi with addition of dragon fruit peel. This high dietary fiber will be beneficial to humans, especially good for the digestive system. Meanwhile, the mineral content of gnocchi with dragon fruit peel also showed that the F3 sample had the highest mineral content, in particular — iron (Fe) in amount of 1.886 mg/100 g, potassium (K) 6.179 mg/100 g, and calcium (Ca) in amount of 25.339 mg/100 g. This also shows that the addition of dragon fruit peel is useful for improvement of human health and the quality of food product, i. e. gnocchi by increasing the total content of dietary fiber and improving the mineral composition of gnocchi due to addition of dragon fruit peel.

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УВЕЛИЧЕНИЕ СОДЕРЖАНИЯ КЛЕТЧАТКИ И МИНЕРАЛОВ В НЬОККИ С ДОБАВЛЕНИЕМ КОЖУРЫ ПИТАХАЙИ, ИСПОЛЬЗУЕМОЙ В КАЧЕСТВЕ ЗАМЕНИТЕЛЯ ИНГРЕДИЕНТА, ДЛЯ УЛУЧШЕНИЯ КАЧЕСТВА ПИЩЕВОГО ПРОДУКТА И ПОДДЕРЖАНИЯ ЗДОРОВЬЯ ЧЕЛОВЕКА

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КЛЮЧЕВЫЕ СЛОВА:
Hylocereus undatus, питание, макароны, нулевой голод

АННОТАЦИЯ

Ньокки, или клецки — это разновидность домашней пасты, приготовленной из картофеля, муки и яиц. Улучшить качество пищевых продуктов, а в частности — ньокки, в плане их питательности теперь можно и с помощью побочных продуктов, при переработке другого вида сырья. Помимо улучшения качества пищевых продуктов и поддержания здоровья человека, добавление кожуры питахайи (драгонфрут, драконьего фрукта), которые считаются побочными продуктами при переработке данного фрукта, может стать разумным решением или идеей по ее переработке. В данном исследовании произведенный пищевой продукт представлял собой ньокки с добавлением побочного продукта — кожуры питахайи, котопый затем подвергался анализу на содержание клетчатки и следующих минералов: железа, калия, кальция. Полученные данные затем подвергались статистическому анализу с использованием программы SPSS для определения эффекта вариации с помощью Т-теста. По результатам исследования был сделан вывод, что содержание пищевых волокон кожуры драконьего фрукта в образце ньокки, обозначенном как F3, характеризовалось самым высоким содержанием водорастворимых пищевых волокон, равным 1,33%, содержанием водонерастворимых пищевых волокон, равным 1,86%, и общим содержанием пищевых волокон, равным 3,19%. Это также показывает, что чем больше добавляется кожуры питахайи, тем выше становится общее содержание пищевых волокон в ньокки, приготовленных с добавлением кожуры питахайи. Такое высокое содержание клетчатки будет полезно для человека, особенно полезно для пищеварительной системы. Между тем, содержание минеральных веществ в ньокки, приготовленных

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с добавлением кожуры питахайи, также показало, что образец под обозначением F3 имел самое высокое содержание минералов, в частности — железа (Fe) в количестве 1,886 мг/100 г, калия (K) в количестве 6,179 мг/100 г, и кальция (Ca) — 25,339 мг/100 г. Это также показывает, что добавление в продукт кожуры питахайи улучшает здоровье человека и повышает качество пищевых продуктов, это же относится и к ньокки за счет увеличения общего содержания пищевых волокон и улучшения минерального качественного состава за счет добавления кожуры питахайи.

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1. Introduction

Food waste is a concept of the final stage of the food chain. It is obtained at stages of the distribution, retail, it's processing at household or restaurant. We need to start analyzing the need to manage waste rationally and intelligently with the aim of reducing the risk of lowering down the comfort of life [1]. It is estimated that the world discards more than 1 billion tons of food waste, which is one third of the annual food production [2]. One of the negative contributions to the environment comes from food waste, which can cost society and households a great deal of money [3]. Household food waste is caused by poor practices of food handling [4]. The main challenge in solving the food waste problem is the lack of knowledge, analysis and solution methods [5]. Other studies have shown that moral principles can directly influence patterns of food disposal behavior, eating habits, food consumption patterns, knowledge or ideas about food recycling [6].

There is a study that considers the types of food that are often thrown away by students at least once a week, shows the percentage of each type of food consisting of fruits, vegetables, and bread (perishable food) [7]. Waste disposal of different types of vegetables and fruits is an activity that is often practiced in food processing production [8]. The recycling of fruit and vegetable waste (FVW) is a major challenge due to its damage-sensitive nature and heterogeneity [9]. As a food ingredient, fruit and vegetable waste is readily available, inexpensive, and facilitates the improvement of the environmental situation by reducing the volume of waste via its processing [10].

Food waste is a problem that needs to be solved in addition to education, one of which is to conduct research on the reprocessing of food waste produced by the consumers. The processing of food waste generally aims to provide positive impact on the global community. One type of fruit that has food waste potential is dragon fruit; the outer part or skin of dragon fruit, which is quite large and heavy, is simply discarded without further processing [11].

Dragon fruit [*Hylocereus* spp.], an exotic fruit originating from South America. Dragon fruit belongs to the Cactaceae family and is a popular fruit in Asia with high nutritional content [12,13]. The total calorie count of dragon fruit is very low compared to other fruits. In addition, dragon fruit also provides a high amount of various minerals, including potassium, magnesium, calcium, iron, copper, and contains vitamins, especially vitamin C, biotin, K1, and D [14].

There are five main species that are distinguished based on the characteristics of the fruit, specifically I) *H. undatus* with white flesh and pink skin, II) *H. polyrhizus*, red flesh and pink skin, III) *H. costaricencis* and red-purple flesh and pink skin, IV) *H. guatemalensis* with red flesh and reddish-orange skin, and the last one V) *H. megalanthus* white flesh and yellow skin. Dragonfruit flesh peculiar feature are black speckled seeds that can be eaten. Other characteristics of dragon fruit are that it has a sweet taste, is high in nutrients such as soluble sugars, protein and minerals such as potassium, magnesium and calcium [15,16].

Dragon fruit is one of the exotic fruit species that has received relatively little research in the food and pharmaceutical industries. However, the regeneration system of red dragon fruit or H. polyrhizus is highly efficient [17]. Consumers are very interested in dragon fruit because of its unique shape and resistance to the threat of drought, so it is known to be high in nutrients. The polyphenols are extracted from dragon fruit peel in the production of dragon fruit peel juice and puree [18].

Pitaya or dragon fruit is a plant that has an exotic color, nutrients and antioxidants that are very good, while the skin contains betalain, flavonoids and phenols that are a good source of extracts for human health. The color of dragon fruit peel waste and flesh has pigment of stable strength, containing in particular with betalain, which contains nitrogen composed of betacyanin and betaxanthin [19]. Betalain pigment in dragon fruit is useful because it contains a lot of polyphenols, vitamins, sugars, amino acids, and has natural elements that are used for maintenance of health because it contains betalain pigment [20,21]. Red dragon fruit peels *(H. undatus)* is very effective when used, and the extract contains nutritional phytochemical components and also has antioxidant activity [22,23]. Dragon fruit peel can add value to the industry as the extract from red dragon fruit peel [24].

Dragon fruit peel waste can be recycled into various types of food. Recycling is not only used for processing the food wastes, but also for adding nutritional value to a food. Several studies have found out how to transform dragon fruit peels into dessert pies, nata, and cookies [11,25,26]. The type of utilization of dragon fruit peels waste for savory food has also been studied, especially dragon fruit peels processed into meatballs, chicken nuggets, and tempe [27,28,29]. Dragon fruit peel has potential as a source of purplish red color with moderate antioxidant activity for food decoration [30]. One of the inspiring studies on the addition of dragon fruit peel is the use of dragon fruit peel in noodles [31]. From previous studies, it can be concluded that dragon fruit peel can be recycled into various products. One of the foods that can be used as an innovation is dragon fruit peel gnocchi noodles.

Pasta is a delicious favorite and signature dish of many of the world's most famous chefs, and a comfort food for millions of people worldwide. Pasta is often referred to as a fattening food, so it is necessary to formulate a functional pasta that possesses functional properties and nutritional value. Different formulations of pasta have been developed to improve its nutritional profile [32,33]. Gnocchi pasta is one of the most popular and appreciated Italian dishes, gnocchi is also often called as potato-based pasta [34,35].

There are different types of gnocchi innovations, one of which is the addition of orange-fleshed sweet potatoes to make it an interesting innovative food product [36]. Gnocchi are made of potatoes, flour, eggs and salt. It is made by boiling whole raw potatoes, then mashing them and finally mixing them with other ingredients. The dough is then formed into small pieces with the typical shape of gnocchi. Finally, the gnocchi are cooked using the method of boiling. The quality of gnocchi is usually judged by its color, cooking quality and texture. Cooked gnocchi should remain firm and not lose any solids into the cooking water, and should not become sticky when left to rest a little after cooking [35].

In Using dragon fruit peel in gnocchi food products apart from reducing fruit waste and turning the food ingredients into new products in such a way that the product will have a higher usability; the main focus of dragon fruit peel gnocchi processing is to produce products with better content of fiber and minerals. In addition, this study aims to determine the effect of dragon fruit peel substitution on fiber and minerals iron, potassium, calcium in gnocchi.

2. Objects and methods

The making of dragon fruit skin gnocchi is carried out in the Akademi Kuliner dan Patiseri OTTIMMO Internasional Kitchen Lab while the nutritional analysis of dragon fruit skin gnocchi was carried out at the Nutrition Laboratory, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia using international standard tests.

2.1. Ingredients for making dragon fruit peels gnocchi

The ingredients used in the manufacture of dragon fruit peels gnocchi is shown in Table 1.

Table 1. **Gnocchi formulation**

Таблица 1. **Состав ньокки**

Ingredients	F1 100%:0%	F2 90%:10%	F3 80%:20%
Potato	500 g	450 g	400 g
All purpose flour	125 g	125 g	125 g
Parmesan chesse	50 g	50 g	50 g
Salt	3 g	3 g	3 g
White peper	1 g	1 g	1 g
Egg	50 g	50 g	50 g
Gragon fruit peel	0	50 g	100 g

2.2. Methods for making dragon fruit peels gnocchi

This study is experimental research, where the object to be studied is deliberately made by conducting real experiments in the real life environment with the intention of seeing the results of the processing. In this study, the food being produced was dragon fruit peel gnocchi, which was tested for fiber content and minerals iron, potassium, calcium. The processing used was the addition or substitution of potatoes with dragon fruit peel at various ratios, specifically 100%:0%, 90%:10% and 80%:20%. The gnocchi cooking process consists of steaming and then mashing the potatoes, smoothing the dragon fruit peel, mixing all the ingredients, forming the dough, boiling the dough and finally resting the gnocchi. The gnocchi were also tested for fiber and mineral content.

2.2.1. Fiber content measurements dragon fruit peels waste gnocchi

According to Stelmock et al. [37], the Van Soest method of acid detergent fiber (ADF) analysis is as follows: 1) Weighing (OHAUS Pioneer PX 2202 E, Shanghai, China) the dragon fruit peel gnocchi sample weighing of 0.3 gram then was placed in a 50 mL test tube; 2) Adding 40 mL of ADF solution then closing the test tube tightly; 3) Cooking in boiling water for 1 hour; 4) Filtering with sintered glass of known weight while sucking with a vacuum pump; 5) Washing with approximately 100 mL of boiling water until the foam disappears, and washing with 50 mL of alcohol; 6) Baking (Memmert UN55, Germany) at 100 °C for 8 hours or leave overnight; 7) Cooling in a desiccator (DURAN NOVUS NS24/29, Germany) approximately one hour after weighing [37].

The Van Soest acid detergent fiber method can also be used to determine the fiber content in shellfish chitin, the results show that chitin is a significant fibrous fraction. In the research method before analysis, tanner crab meal (TCM) samples were separated by 40-mesh sieve (US equivalent of a Tyler Standard sieve) into two fractions, coarse (>40-mesh) and fine (<40-mesh) (6), and these two fractions were compared with the standard commercial TCM. Total nitrogen was determined on shellfish meal samples before and after ADF analysis with an automatic continuous flow methodology in an auto analyzer II system (8, 20). Crude protein contents for shellfish meal substrates were corrected for chitin nitrogen based on 6.7% nitrogen (N) in chitin. Percent chitin ADFmethods of analysis were calculated as: (A = 100 (B – C)/D) where: A = percent chitin; B = oven dry weight of residue; C = residual ash weight; D = original dry sample weight [37].

2.2.2. Mineral content measurements in the dragon fruit peels gnocchi

Mineral concentration is an important value to determine the nutritional quality of a food. In this study, the levels of iron, potassium and calcium were determined using the AAS method. The advantages of the Atomic Absorption Spectrometer (AAS) (230ATS AAS Buck Scientific, USA) method are high sensitivity, good accuracy, low cost and relative simplicity. The principle of testing the content of minerals by AAS is the absorption of light by free atoms in the gas phase. The concentration of the analyte is determined by the amount of light absorbed at a specific wavelength. The solid sample of gnocchi is crushed finely to form Food Matrix infant formula. AAS provides high sensitivity, good precision, low cost, relative simplicity [38].

2.3. Data processing and statistical analysis

All data were obtained using a randomized design and then statistically analyzed using the SPSS19.0 program to determine the effect of variation using the T-test.

3. Results and discussion

3.1. Fiber content

Dietary fiber is identified based on its composition, analysis, and physiological activity [39]. Total dietary fiber consists of soluble dietary fiber and insoluble dietary fiber [40].

3.1.1. Level of water-soluble food fiber content of dragon fruit peels gnocchi

The results analysis of the water-soluble food fiber content on dragon fruit peels gnocchi are shown in Table 2.

Based on Table 2, the average content of water soluble food fiber in all samples was 1.21%, while sample F3 had the highest water soluble food fiber content in amount of 1.33%. After obtaining the data from the laboratory tests, the data were analyzed using the T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value, which is less than 0.05.

Table 2. **The results analysis of the water soluble food fiber content on dragon fruit peels waste gnocchi**

Таблица 2. **Результаты анализа на содержание водорастворимой пищевой клетчатки в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Water Soluble Food Fiber (%)
F1	1.09
F2	1.21
F3	1.33

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

3.1.1. Content of water insoluble food fiber content of dragon fruit peels gnocchi

The results of the analysis of the water-soluble food fiber content on dragon fruit peels gnocchi are shown in Table 3.

Table 3. **The results of analysis of the water insoluble food fiber content on dragon fruit peels waste gnocchi**

Таблица 3. **Результаты анализа на содержание нерастворимой в воде пищевой клетчатки в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Water insoluble food fiber (%)
F1	1.67
F2	1.75
F3	1.86

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

Based on Table 3, the average content of water insoluble food fiber in all samples was 1.76%, while sample F3 had the highest water insoluble food fiber content in amount of 1.86%. After obtaining the data from the laboratory tests, the data were analyzed using the T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value, which is less than 0.05.

3.1.2 Total food fiber content in dragon fruit peels gnocchi

The results of analysis of the total food fiber content in dragon fruit peels gnocchi are shown in Table 4.

Table 4. **The results of analysis of the total food fiber content on dragon fruit peels gnocchi**

Таблица 4. **Результаты анализа на общее содержание пищевой клетчатки в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Total Food Fiber (%)
F1	2.76
F2	2.96
F3	3.19

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

Based on Table 4, the average total food fiber content of the total sample was 2.97%, where sample denoted as F3 has the highest total food fiber content in amount of 3.19%.

Red dragon fruit or commonly called *H. polyrhizus* has a skin that is generally disposed of as waste; the skin has a relatively large weight, which is about 22% of the total weight of the red dragon fruit. The total dietary fiber contained in red dragon fruit peel waste has a very high percentage of about 69.3%, among them 14.82% soluble dietary fiber (SDF) and 56.50% insoluble dietary fiber (IDF) [41]. Dietary fiber is the portion of plant material in foods that is resistant to enzymatic digestion [42]. In addition, dragon fruit peel is a natural functional food ingredient that has a relatively high total dietary fiber, so the more it is used, the higher the fiber content of dragon fruit peel gnocchi is. After obtaining the data from the laboratory tests, the data were analyzed using the T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value, which is less than 0.05.

In red dragon fruit, fiber has an inherent pigment called betacyanin that gives a distinctive red color [43]. In humans, dietary fiber can also aid intestinal motility, increase insulin sensitivity, and increase satiety, allowing people to reduce their overall energy intake [44]. The coloring of foods not only provides a pleasant color, but also enhances the attractiveness and gives the product its natural value [45]. The beneficial effect given by dietary fiber, when consumed, will help fight diseases, while being non-carbohydrate components [46]. The high fiber content may func-

tion to facilitate bowel movements in human bodies [47]. The beneficial properties of soluble dietary fiber have been attributed to its important role in human physiological functions consisting of lowering cholesterol levels, lowering blood pressure levels, preventing gastrointestinal problems, protecting against some cancers, increasing the bioavailability of minerals, and many others. Dietary fiber has a potential functional role in regulating physical and human health [40,48]. In general, foods rich in dietary fiber have a low glycemic index (GI). Foods with a low glycemic index and high fiber content benefits for the human health such as reducing postprandial glucose, improving insulin responses, improving lipid profiles and reducing insulin resistance. In addition, the daily diet of normal people (non-diabetics) with the consumption of carbohydrate-rich foods that are high in fiber and low in GI may protect against several diseases such as *diabetes mellitus* and cardiovascular diseases [49].

3.2. Minerals content

Dragon fruit peels gnocchi were tested for content of minerals — iron, potassium, calcium.

3.2.1. Content of iron (Fe) in dragon fruit peels gnocchi

The results of analysis of the iron (Fe) content in dragon fruit peels gnocchi are shown in Table 5.

Table 5. **The results of analysis of Fe content in dragon fruit peels gnocchi**

Таблица 5. **Результаты анализа на содержание железа (Fe) в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Iron (Fe) Content (mg/100 g)
F1	1.759
F2	1.797
F3	1.886

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

Based on Table 5, the average content of iron (Fe) in all samples was 1.814 mg/100 g, where sample F3 had the highest Fe content in amount of 1.886 mg/100 g. After obtaining data from laboratory tests, the data were analyzed using T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value which is smaller than 0.05. The dragon fruit peel sample featured the concentration of fatty iron (Fe) of 273,955 ppm. Iron is an essential nutrient for humans, especially for women between the ages of 14 and 50, pregnant women, and infants in the first months of life who need to get an adequate supply of iron [50,51].

3.2.2 Content of potassium (K) in dragon fruit peels gnocchi

The results of analysis of the potassium (K) content in dragon fruit peels gnocchi are shown in Table 6.

Table 6. **The results analysis of potassium (K) content in dragon fruit peels gnocchi**

Таблица 6. **Результаты анализа на содержание калия (K) в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Potassium (K) Content (mg/100 g)
F1	5.764
F2	5.888
F3	6.179

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

Based on Table 6, the average content of potassium (K) in all samples was 5.944 mg/100 g, while sample F3 had the highest potassium content in amount of 6.179 mg/100 g. After obtaining the data from the laboratory tests, the data were analyzed using the T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value, which is less than 0.05. In dragon fruit peel, the element with the highest concentration is potassium at rate of 1081 ppm. Potassium is very important for maintaining water content and acid balance in the body, therefore dragon fruit peel is a good source of potassium [50].

3.2.3 Content of calcium (Ca) in dragon fruit peels gnocchi

The results of analysis of the calcium (Ca) content in dragon fruit peels gnocchi are shown in Table 7.

Table 7. **The results of analysis of calcium (Ca) content in dragon fruit peels gnocchi**

Таблица 7. **Результаты анализа на содержание кальция (Ca) в ньокки, приготовленных с добавлением кожуры питахайи**

Sample	Calcium (Ca) Content (mg/100 g)
F1	23.638
F2	24.148
F3	25.339

Note: Different superscript numbers in the same column indicate significant differences (α = 5%).

Based on Table 7, the average calcium (Ca) content in all samples was 24.375 mg/100 g, while sample F3 had the highest calcium content in amount of 25.339 mg/100 g. After obtaining data from laboratory tests, the data were analyzed using the T-test at $p \leqslant 0.05$. The results obtained were significantly different for the samples F1, F2 and F3 indicated by the Sig value, which is less than 0.05.

The concentration of calcium in dragon fruit peel is 9.75 ppm = = 0.975 mg/100 g [52]. Calcium is used to build a skeleton during a person's childhood, which is important to prevent osteoporosis later in life [53]. Innovative food products need to be developed because humans have now started to think about it and prioritize their health, the type of food they eat, and the exercise they do to stay away from health problems [54]. Increasing the digestibility of calcium, iron and magnesium can prevent the development of osteoporosis [55].

4. Conclusion

Based on the results of the study, it was concluded that the dietary fiber content of dragon fruit peel gnocchi in the sample F3 had the highest water soluble dietary fiber content in amount of 1.33%, water insoluble dietary fiber content in amount of 1.86%, and total dietary fiber content in amount of 3.19%. This also shows that the more dragon fruit peel is added, the higher is the total dietary fiber content in dragon fruit peel gnocchi. This high dietary fiber will be beneficial to human health, especially good for the digestive system. Meanwhile, the mineral content of gnocchi in dragon fruit peel also showed that the sample F3 had the highest mineral content, specifically iron (Fe) in amount of 1.886 mg/100 g, potassium (K) in amount of 6.179 mg/100 g, and calcium (Ca) in amount of 25.339 mg/100g. This also shows that the more dragon fruit peel is added, the higher is the mineral content in dragon fruit peel gnocchi. The addition of dragon fruit peel is useful in improving the quality of food products, in addition to increasing the total content of dietary fiber in dragon fruit peel gnocchi, it can also improve the mineral composition of dragon fruit peel gnocchi products, ~~at~~ since the level of iron (Fe) is an important nutrient for human health, especially for women and children, as well as the infants who need to get an adequate supply of iron. Potassium (K) is essential for maintaining the body's acid balance, and calcium (Ca) which serves to build the skeleton in a person's childhood and is important for preventing osteoporosis later in life. The development of innovation food product can be used to raise nutrition value to the food product that is very suitable for people who prioritize health.

REFERENCES

1. Seberini, A. (October 9–10, 2019). *Economic, social and environmental world impacts of food waste on society and Zero waste as a global approach to their elimination*. The 19th International Scientific Conference Globalization and its Socio-Economic Consequences 2019 — Sustainability in the Global-Knowledge Economy. Rajecke Teplice, Slovakia. https://doi.org/10.1051/shsconf/20207403010
2. Habashy, M.M., Ong, E. S., Abdeldayem, O.M., Al-Sakkari, E.G., Rene, E.R. (2021). Food waste: A promising source of sustainable biohydrogen fuel. *Trends in Biotechnology*, 39(12), 1274–1288. https://doi.org/10.1016/j.tibtech.2021.04.001
3. Kim, J., Rundle-Thiele, S., Knox, K., Burke, K., Bogomolova, S. (2020). Consumer perspectives on household food waste reduction campaigns. *Journal of Cleaner Production*, 243, Article 118608. https://doi.org/10.1016/j.jclepro.2019.118608
4. Principato, L., Mattia, G., Di Leo, A., Pratesi, C.A. (2021). The household wasteful behaviour framework: A systematic review of consumer food waste. *Industrial Marketing Management*, 93, 641–649. https://doi.org/10.1016/j.indmarman.2020.07.010
5. Withanage, S.V., Dias, G.M., Habib, K. (2021). Review of household food waste quantification methods: Focus on composition analysis. *Journal of Cleaner Production*, 279, Article 123722. https://doi.org/10.1016/j.jclepro.2020.123722
6. Aydin, A.E., Yildirim, P. (2021). Understanding food waste behavior: The role of morals, habits and knowledge. *Journal of Cleaner Production*, 280(1), Article 124250. https://doi.org/10.1016/j.jclepro.2020.124250

7. Mondéjar-Jiménez, J.A., Ferrari, G., Secondi, L., Principato, L. (2016). From the table to waste: An exploratory study on behaviour towards food waste of Spanish and Italian youths. *Journal of Cleaner Production*, 138(1), 8–18. https://doi.org/10.1016/j.jclepro.2016.06.018
8. Gavahian, M., Sastry, S.K. (2020). Ohmic-assisted peeling of fruits: Understanding the mechanisms involved, effective parameters, and prospective applications in the food industry. *Trends in Food Science and Technology*, 106, 345–354. https://doi.org/10.1016/j.tifs.2020.10.027
9. Esparza, I., Jiménez-Moreno, N., Bimbela, F., Ancín-Azpilicueta, C., Gandía, L.M. (2020). Fruit and vegetable waste management: Conventional and emerging approaches. *Journal of Environmental Management*, 265, Article 110510. https://doi.org/10.1016/j.jenvman.2020.110510
10. Kupaeva, N. V., Kotenkova, E.A. (2019). Search for alternative sources of natural plant antioxidants for food industry. *Food Systems*, 2(3), 17–19. https://doi.org/10.21323/2618-9771-2019-2-3-17-19
11. Rahmah, L., Ansori, A.N.M., Choiriyah, N.A., Iskandar, H.T., Hadiwirawan, G.Y., Rebezov, M. et al. (2022). Substitution of dragon fruit peels on vitamin C, water content, and fiber in milk pie to improve human health. *Research Journal of Pharmacy and Technology*, 15(8), 3690–3696. https://doi.org/10.52711/0974-360X.2022.00619
12. Pedda, K.D., Sai, K.N., Suneetha, P., Bramareswara, R.K., Naresh, K.M., Krishna, M.S.R. (2019). Multiple shoot regeneration in seed-derived immature leaflet explants of red dragon fruit (*Hylocereus costaricensis*). *Research Journal of Pharmacy and Technology*, 12(4), 1491–1494. https://doi.org/10.5958/0974-360X.2019.00246.4
13. Cruz, M.M., Reyes, J., Angeles, H.G., Del Rosario, J.M., Lirazan, M.B., Estacio, R.C. et al. (2022). Antioxidant, anti-tyrosinase, and anti-angiogenic activities of dragon fruit (Hylocereus spp.). *Food Research*, 6(3), 403–410. https://doi.org/10.26656/fr.2017.6(3).400
14. Arivalagan, M., Karunakaran, G., Roy, T.K., Dinsha, M., Sindhu, B.C., Shilpashree, V.M. et al. (2021). Biochemical and nutritional characterization of dragon fruit (Hylocereus species). *Food Chemistry*, 353(4), Article 12942. https://doi.org/10.1016/j.foodchem.2021.129426
15. Tran, D.-H., Yen, C.-R., Chen, Y.-K.H. (2015). Effects of bagging on fruit characteristics and physical fruit protection in red pitaya (*Hylocereus spp.*). *Biological Agriculture and Horticulture*, 31(3), 158–166. https://doi.org/10.1080/01448765.2014.991939
16. Silva, A.C.C., Sabião, R.R., ChiamolerA, F.M., Segantini, D.M., Martins, A.B.G. (2017). Morphological traits as tool to verify genetic variability of interspecific dragon fruit hybrids. *Revista Brasileira de Fruticultura*, 39(1), Article e168. https://doi.org/10.1590/0100-29452017168
17. Qin, J., Wang, Y., He, G., Chen, L., He, H., Cheng, X. et al. (2017). High-efficiency micropropagation of dormant buds in spine base of red pitaya (Hylocereus polyrhizus) for industrial breeding. *International Journal of Agriculture and Biology*, 19(1), 193–198. https://doi.org/10.17957/IJAB/15.0264
18. Bai, X., Zhou, T., Lai, T., Zhang, H. (2018). Optimization of the microwave-assisted extraction of polyphenols from red pitaya peel using response surface methodology. *Journal of Scientific and Industrial Research*, 77(7), 419–424.
19. Hua, Q., Chen, C., Tel Zur, N., Wang, H., Wu, J., Chen, J. et al. (2018). Metabolomic characterization of pitaya fruit from three red-skinned cultivars with different pulp colors. *Plant Physiology and Biochemistry*, 126, 117–125. https://doi.org/10.1016/j.plaphy.2018.02.027
20. Nur'Aliaa, A.R., Siti Mazlina, M.K., Taip, F.S. (2011). Effects of commercial pectinases application on selected properties of red pitaya juice. *Journal of Food Process Engineering*, 34(5), 1523–1534. https://doi.org/https://doi.org/10.1111/j.1745-4530.2009.00388.x
21. Song, H., Chu, Q., Yan, F., Yang, Y., Han, W., Zheng, X. (2016). Red pitaya betacyanins protects from diet-induced obesity, liver steatosis and insulin resistance in association with modulation of gut microbiota in mice. *Journal of Gastroenterology and Hepatology*, 31(8), 1462–1469. https://doi.org/https://doi.org/10.1111/jgh.13278
22. Velaga, V.S.A.R., Suryadevara, N., Ying, R.T.C., Ponmurugan P, Devi, G. (2020). Analgesic activity of *Annona squamosa* Linn fruit peels on Swis Albino mice. *Research Journal of Pharmacy and Technology*, 13(7), 3199–3204. https://doi.org/10.5958/0974-360X.2020.00566.1
23. Devi, N.K.D., Ganji, S., Maddu, P., Jasti, P., Merla, M., Varicola, K.S. (2014). Antioxidant and anthelmintic potential of *Borassus flabellifer* kernel peels. *Research Journal of Pharmacognosy and Phytochemistry*, 6(4), 181–186.
24. Yogita, T., Pravin, C., Akshay, M., Akahay, S., Sudam, N., Aditee, K. et al. (2019). *in vivo* and *in-vitro* evaluation of antimicrobial activity of peel extracts of red dragon fruit (*Hylocereus polyrhizus*). *Research Journal of Pharmacognosy and Phytochemistry*, 11(1), 23–26. https://doi.org/10.5958/0975-4385.2019.00005.0
25. Nur'aini, H., Sari, E.R. (October 12–13, 2015). *Quality Identification of Dragon Fruit Peel (Hylocereus undatus) Nata with Sucrose Concentration Variation*. International Seminar on Promoting Local Resources for Food and Health. Bengkulu, Indonesia.
26. Chumroenvidhayakul, S., Thilavech, T., Abeywardena, M. (2023). Dragon fruit peel waste (*hylocereus undatus*) as a potential ingredient for reducing lipid peroxidation, dietary advanced glycation end products, and starch digestibility in cookies. *Antioxidants,* 12(5), Article 1002. https://doi.org/10.3390/ antiox12051002
27. Rahmah, L., Choiriyah, N.A. (October 13–14, 2022). *Increasing levels of fibre and mineral (Fe, Ca, and K) in chicken meatballs added dragon fruit peel and oyster mushroom*. IOP Conference Series: Earth and Environmental Science, Banda Aceh, Indonesia. https://doi.org/10.1088/1755-1315/951/1/012093
28. Lubis, N., Agustiono, J., Ismail, D., Pradana, T.G. (2020). Effect of red dragon fruit peels (Hylocereus polyrhizus) as a natural dye and preservatives on chicken nuggets. *International Journal of Research and Review*, 7(3), 168–174.
29. Damiati, D., Suriani, M. (December 21, 2021). *Nutritional and Organoleptic Quality of Tempe Now with the Addition of Natural Dyeing Ingredients.* Proceedings of the 4th International Conference on Innovative Research Across Disciplines (ICIRAD2021). Atlantis Press. Amsterdam, Paris. https://doi.org/10.2991/assehr.k.211222.038
30. Lourith, N., Kanlayavattanakul, M. (2013). Antioxidant and stability of dragon fruit peel colour. *Agro Food Industry Hi Tech*, 24(3), 56–58.
31. Enjelina, W., Rilza, Y.O., Erda, Z. (2019). Utilization of red dragon fruit (hylocereus polyrhizus sp.) peel to prolong wet noodles shelf-life. *AcTion: Aceh Nutrition Journal,* 4(1), 63–69.
32. Krishnan, M., Prabhasankar, P. (2012). Health based pasta: Redefining the concept of the next generation convenience food. *Critical Reviews in Food Science and Nutrition*, 52(1), 9–20. https://doi.org/10.1080/10408398.2010.486909
33. Bresciani, A., Pagani, M.A., Marti, A. (2022). Pasta-making process: A Narrative review on the relation between process variables and pasta quality. *Foods*, 11(3), Article 256. https://doi.org/10.3390/foods11030256
34. Santagata, G., Zannini, D., Mallardo, S., Boscaino, F., Volpe, M.G. (2021). Nutritional and chemical-physical characterization of fresh pasta gnocchi prepared with sea water as new active ingredient. *Foods*, 10(11), Article 2585. https://doi.org/10.3390/foods10112585
35. Alessandrini, L., Balestra, F., Romani, S., Rocculi, P., Rosa, M.D. (2010). Physico-chemical and sensory properties of fresh potato-based pasta (*Gnocchi*). *Journal of Food Science,* 75(9), S542-S547. https://doi.org/10.1111/j.1750-3841.2010.01842.x
36. da Silva, E.M.M., Rossini, A.F., de Carvalho, J.L.V. (2016). Quality evaluation of gnocchi pasta prepared with orange-fleshed sweet potato. *Bioscience Journal*, 32(1), 81–88. https://doi.org/10.14393/BJ-v32n1a2016-29598
37. Stelmock, R.L., Husby, F.M., Brundage, A.L. (1985). Application of van soest acid detergent fiber method for analysis of shellfish chitin. *Journal of Dairy Science*, 68(6), 1502–1506. https://doi.org/10.3168/jds.S0022-0302(85)80989-9
38. Noh, M.F., Gunasegavan, R.D.-N., Khalid, N.M., Balasubramaniam, V., Mustar, S., Rashed, A.A. (2020). Recent techniques in nutrient analysis for food composition database. *Molecules*, 25(19), Article 4567. https://doi.org/10.3390/molecules25194567
39. Dai, F.-J., Chau, C.-F. (2017). Classification and regulatory perspectives of dietary fiber. *Journal of Food and Drug Analysis*, 25(1), 37–42. https://doi.org/10.1016/j.jfda.2016.09.006
40. Chawla, R., Patil, G.R. (2010). Soluble dietary fiber. *Comprehensive Reviews in Food Science and Food Safety*, 9, 178–196.
41. Jamilah, B., Shu, C.E., Kharidah, M., Dzulkifly, M.A., Noranizan, A. (2011). Physico-chemical characteristics of red pitaya (Hylocereus polyrhizus) peel. *International Food Research Journal*, 18, 279–286.
42. Debnath, S., Jawahar, S., Muntaj, H., Purushotham, V., Sharmila, G., Sireesha, K. et al. (2019). A Review on dietary fiber and its application. *Research Journal of Pharmacognosy and Phytochemistry*, 11(3), 109–113. https://doi.org/10.5958/0975-4385.2019.00019.0
43. Bhagya Raj, G.V.S., Dash, K.K. (2020). Ultrasound-assisted extraction of phytocompounds from dragon fruit peel: Optimization, kinetics and thermodynamic studies. *Ultrasonics Sonochemistry*, 68, Article 105180. https://doi.org/10.1016/j.ultsonch.2020.105180
44. Lattimer, J.M., Haub, M.D. (2010). Effects of dietary fiber and its components on metabolic health. *Nutrients*, 2(12), 1266–1289. https://doi.org/https://doi.org/10.3390/nu2121266
45. Shanmugasundaram, P., Bavenro, Rujaswini, T. (2019). A review on food coloring agents — safe or unsafe? *Research Journal of Pharmacy and Technology*, 12(5), 2503–2505. https://doi.org/10.5958/0974-360X.2019.00421.9
46. Dhingra, D., Michael, M., Rajput, H., Patil, R.T. (2012). Dietary fibre in foods: A review. *Journal of Food Science and Technology*, 49, 255–266. https://doi.org/10.1007/s13197-011-0365-5
47. Sathya, K., Nagarajan, K., Jayalakshmi, H., Bharathi, S. (2022). Evaluation of dietary fiber from Borassus flabellifer tuber noodles for enhancing bowel movement-Optimization by using Response Surface Methodology. *Research Journal of Pharmacy and Technology*, 15(2), 807–813. https://doi.org/10.52711/0974-360X.2022.00134
48. Ali, M.R., Mohamed, R.M., Abedelmaksoud, T.G. (2021). Functional strawberry and red beetroot jelly candies rich in fibers and phenolic compounds. *Food Systems,* 4(2), 82–8. https://doi.org/10.21323/2618-9771-2021-4-1-82-88
49. Pivnenko, T. N. (2023). Functional properties of the dietary fibers and their using in the manufacturing technology of fish products. *Food Systems*, 6(2), 233–244. https://doi.org/10.21323/2618-9771-2023-6-2-233-244
50. Zain M.A., Nazeri, N.M.Z. (2016). Antioxidant and mineral content of pitaya peel extract obtained using microwave assisted extraction (MAE). *Australian Journal of Basic and Applied Sciences*, 10(17), 63–68.
51. Chakravarty, M., Venugopal, R., Chakraborty, A., Mehta, S.K., Varoda, A. (2022). A study of nutritional status and prevalence of anaemia among the adolescent girls and women of reproductive age of baigatribe accessing antenatal clinic in public health sector in Chhattisgarh, India. *Research Journal of Pharmacy and Technology*, 15(2), 598–604. https://doi.org/10.52711/0974-360X.2022.00098
52. Mir-Marqués, A., Domingo, A., Cervera, M.L., de la Guardia, M. (2015). Mineral profile of kaki fruits (*Diospyros kaki* L.). *Food Chemistry*, 172(8), 291–297. https://doi.org/10.1016/j.foodchem.2014.09.076
53. Thamarai, Nivetha, Durai Raj V. P.M., Manivannan, S.S. (2018). Calorie measurement: Predicting the nutrient content of food using image analysis. *Research Journal of Pharmacy and Technology,* 11(3), 959–963. https://doi.org/10.5958/0974-360X.2018.00179.8
54. Puchkova, T.S., Pikhalo, D.M., Karasyova, O.M. (2019). About the universal technology of processing jerusalem artichoke and chicory for inulin. *Food Systems*, 2(2), 36–43. https://doi.org/10.21323/2618-9771-2019-2-2-36-43

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