ORIGINAL ARTICLE

Utilisation of Papaya Peel Flour as Source of Fibre in Festive Cookie, Pineapple Tart

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Abstract:

A pineapple tart with good source of fibre was developed by utilising papaya peel flour as part of the ingredients to increase the fibre content. Fresh papaya was peeled, cut into small pieces, further washed, oven dried and finely ground to powder form. The papaya peel flour contained 12.2% crude fibre content and further used in festive cookie formulation. The new pineapple tart was formulated by substituting 4% and 10% papaya peel flour with wheat flour in the present investigation. The percentage of moisture, ash, fat, protein, crude fibre, and total carbohydrate content of all pineapple tart formulations were determined. The average percentage of crude fibre in 1g of new developed pineapple tart with 10% papaya peel flour substitution sample is 4.1%. This followed by the new developed pineapple tart with 4% papaya peel flour substitution sample which contain 3.8% crude fibre. The experimental result revealed that the new developed pineapple tart contains significant amount of crude fibre content in comparison to the control pineapple tart which improves its nutritional characteristics. Sensory evaluations of all developed pineapple tart were carried out. It was found that 4% papaya peel flour substitution in pineapple tart formulation was accepted by the panelist. Therefore, 4% papaya peel flour based formulated festive cookie, pineapple tart proves enhanced nutritional properties.

Keywords: Papaya peel, fibre, snack, cookie

1. INTRODUCTION

Malaysia is a paradise of food as it offers infinite varieties of different cuisines. When it comes to food, Malaysians are united in their love for it even though our society is divided by belief, culture and creed [1]. Each ethnic group in Malaysia are celebrates other ethnic and religious festivals including Chinese New Year, Hari Raya, Wesak day, Mooncake festivals, Thaipusam, weddings, and many others. Festive cookies and local kuih are the examples of food that results from multicultural. Traditionally, the tart usually served during special preparation only such as during festival celebration or at a wedding ceremony. However, nowadays it can be consumed during breakfast, afternoon snack or can be served as dessert during mealtime [2].

Snacking can be described as eating food or drink between main meals [3]. Snacks usually energy dense, nutrient-poor foods high in carbohydrates, added sugars, fat and sodium but lower in protein and dietary fibre [4, 5]. The prevalence of snacking has increased around the world especially among children. High frequency of snacking may contribute to excessive energy intake in a day which leads to obesity and chronic diseases such as Type 2 Diabetes Mellitus and cardiovascular diseases [3, 6]. Research discovered that one of the reasons of poor dietary habits and intake among adolescents in Malaysia is due to binging on energy-dense snacks and drinks [7].

Based on the result of Malaysian Adult Nutrition Survey (MANS) that carried out in 2002 and 2003, 16.3% of Malaysian adult included bread, local kuih and cookies in top 10 of daily consumed food [8]. In every festival celebration in Malaysia, pineapple tart has been considered as the most traditional and popular snack as it is always served for any celebrations including Chinese New Year, Eid Festive, during Deepavali or even Christmas. Pineapple tarts are small, bite-size pastries filled with or topped with pineapple jam. The main ingredients in this festive cookie are flour, sugar, butter, egg and pineapple jam. By referring to Malaysian Food Composition Database (MyFCD), it has mentioned that the calorie of pineapple tart in 100 g is 452 kcal and it contains 59.7 g of CHO, 6.3 g of protein, 20.9 g of fat, and 0.7 g of fibre [9]. Therefore, it can be emphasised that pineapple tart may contain a higher amount of carbohydrate, added sugar, saturated fat or trans-fat, but a low amount of fibre content.

Fibre is part of the plant material that available in our diet that resists being digested by the enzyme which includes cellulose, the non-cellulosic polysaccharide such as pectic substances, gums, hemicellulose, mucilages and non-

carbohydrate lignin [10]. High dietary fibre intake are associated with low risk of chronic diseases such as colorectal cancer, cardiovascular disease and type 2 diabetes [11]. Nonetheless, a study reported that fibre consumption among global population is low compared to recommendation intake. These countries include the United Kingdom, the United States, Japan and Malaysia [12].

From the list of food items that contain fibre that extracted from MANS 2003, the result reported more than 50% Malaysian adults consumed less than recommended intake of dietary fibre [13]. The recommended intake of fiber for Malaysian is between 20 to 30g per day [14]. Cereals, fruits, vegetables and nut are usually the main source of dietary fibre [10]. In spite of that, the amount and composition of fibre in every food is different. Studies discovered the use of the functional ingredient as additional source of fibre in food by utilising by-products of fruit, which is fruit peel or skin [15].

Carica papaya, usually known as papaya belonged to family Caricaceae. Papaya is considered as one of the contributors to the exportation of fruit in Malaysia. As it undergoes processing, it will lead to a large amount of wastage such as seeds and peels which can cause environmental pollution [16]. Peels and seeds are the major by-products of fruit. On the other hand, few studies have shown that by-products of fruit are actually good sources of bioactive compounds as it contains high level of ß-carotene and lycopene, as well as anthocyanins and flavonoids when compared to the fruit pulps [17]. It can be considered as low-cost renewable resources and can serve as a functional ingredient to enhance the nutrients of a food including fibre [18]. Thus, while contributing to the reduction of industrial waste and cost, this can provide an added value in a product or food and eventually provide a positive economic and environmental impact.

This current research aims to develop a healthy festival cookie as a source of fibre, which is pineapple tart. The crust of pineapple tart is made of a combination of wheat flour and papaya peel flour as the main ingredient. Hence, papaya peel will serve as a functional ingredient in order to increase the fibre content of the pineapple tart. In this research, a proximate analysis was conducted to determine the nutritional content of pineapple tart including determination of carbohydrate, protein, fat, moisture, ash and crude fibre. A sensory evaluation was also evaluated to acknowledge the acceptance of the developed pineapple tart among panelist.

2. MATERIALS AND METHODS

2.1 Ingredients Selection and Development of Pineapple Tart as Source of Fibre

Carica papaya (Papaya) were purchased from fruit market around Selangor. Papayas with stage 4 maturity was chosen in this study, which is 75–100% ripe. Other ingredients that used in this study includes wheat flour, corn starch, butter, egg yolk, icing sugar, milk, salt and pineapple jam were purchased from hypermarket (Tesco and Econsave, Puncak Alam). These ingredients were stored in Food Preparation Laboratory, at 4th floor of FSK 1,5, UiTM Selangor, Puncak Alam Campus.

2.2 Papaya Peel Flour (PPF) Preparation

The papayas were washed with tap water and peeled manually. The peels were washed again from any dirt and cut into small pieces to increase the surface area during drying process. The peels were dried in a Tray Dryer at 60°C for 24 hours [19]. After that, dried peel was finely ground in a food processor and sieved to ensure its homogeneity. Next, the flour was kept in sealed container. The crude fibre content in papaya peel and wheat flour were determined to decide on the formulation of festive cookies [20].

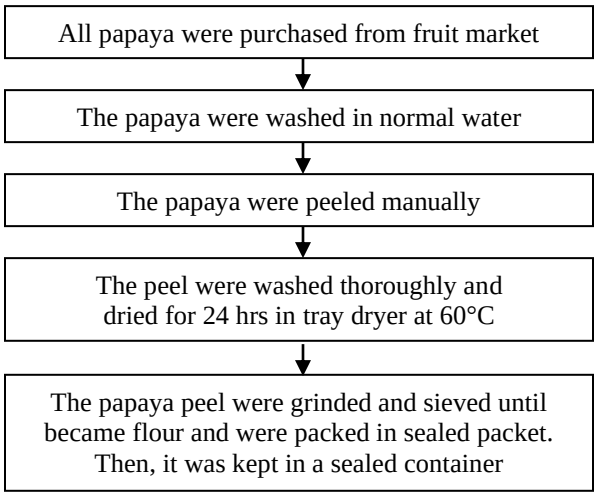
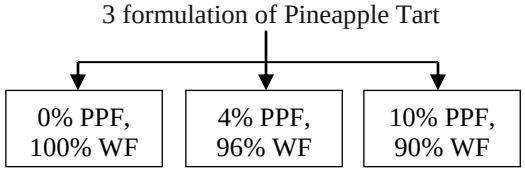


Figure 1: Flow diagram of Papaya Peel Flour Preparation

2.3 Preparation of the Pineapple Tart

Pineapple tart was developed from wheat flour, corn starch, butter, egg yolk, icing sugar, milk, salt and pineapple jam. There are three formulations of pineapple tart. The first formulation was the control, which contained 100% wheat flour. The other two formulations were the substitution of wheat flour with 4% and 10% of papaya peel flour. By using an electric beater, butter, salt and sugar were beaten until mixed. Then, egg yolk was added and beaten together. After that, the mixture was slowly beaten in sifted flour until just combined. The oven was preheated to 170°C. The dough was placed into the mould and piped in 5 cm length. The pineapple jam was placed at one end and rolled up. Lastly, the pineapple tarts were baked till golden brown within 15-20 minutes.



PPF-Papaya peel flour, WF-Wheat flour

Figure 2: Three Formulation of Pineapple Tart

Table 1: The Percentage, ratio and weight of flour

	Percentage of PPF Substituted (%)	Ratio (WF:PPF)	Weight of Wheat Flour (g) in 100g Sample	Weight of Papaya Peel Flour (g) in 100g Sample
V1	0	100:0	46.50	0.00
V2	4	4:96	44.64	1.86
V3	10	10:90	41.85	4.65

PPF-Papaya peel flour, WF-Wheat flour

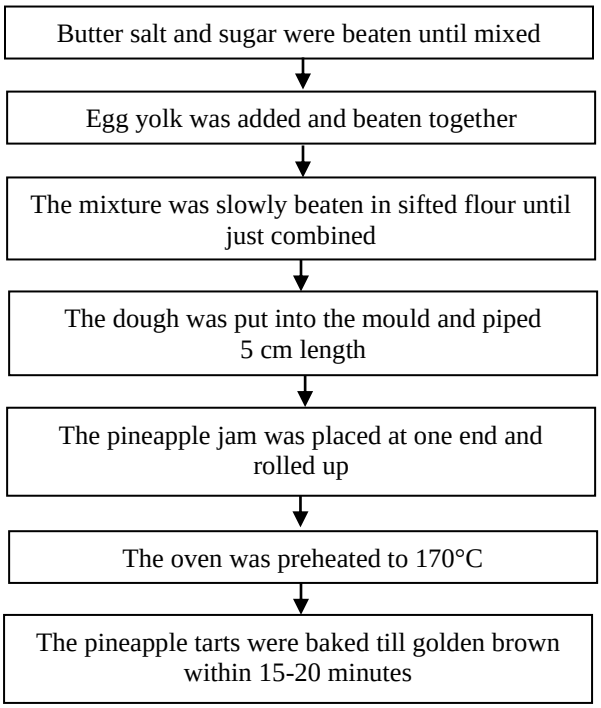


Figure 3: Flow diagram of development of Pineapple Tart

2.4 Proximate Analysis

Sample Preparation

In order to make the pineapple tart suitable for chemical analysis, the pineapple jam were dried at 40°C for 5 days in dehydrator, milled into powder and mixed with tart crust that had been milled. Then, the samples were stored in an airtight container at refrigeration temperature (5°C) until analysis was done [21].

Nutrient Content Analysis

The proximate analysis was carried out in food analysis laboratory in Universiti Teknologi MARA. Analysis on protein determination, using Kjeldhal method and by multiplying the product with conventional conversion factor of 6.25, the crude protein content is achieved. The crude fat determination was carried out using Soxtherm system. The lipids content in food are obtained out by continuous extraction with petroleum ether. The ash content were determined by weighing the ash content which is the inorganic residual after the organic matter has been burnt off. Then, the total mineral content in food sample can be determine. The moisture determination was carried out by weighing the dried food sample to constant weight in an oven. The loss of weight is equal to the moisture content of the food. The determination of crude fibre was carried out by using Wijkstrom fast method. The carbohydrate content of pineapple tart sample was determined by deducting the percentage of other proximate analysis including fat, protein, ash and moisture from 100% via differences [20]

2.5 Sensory Evaluation

The sensory evaluation test was conducted in Food Sensory Laboratory at UiTM Selangor Puncak Alam Campus. Twenty-five participants that meet the inclusion criteria were evaluating three different formulations of pineapple tart in individual cubicles. Each of the participant was presented with 3 sample of pineapple tart, one is the control and the other 2 sample is prepared with different percentage of mixture wheat flour and papaya flour.

i. Inclusion Criteria
   - Age between 15-45 years old [22]
   - Healthy

ii. Exclusion Criteria
   - Has colour-blindness
   - Has gluten-related disorder (eg: Celiac disease)

The participants were judging based on six important criteria including colour, flavour, texture, appearance, aroma and overall acceptance of the samples by using 9-point hedonic scale [23]. This method of scoring of 9-point hedonic scale is in range from dislike extremely until like extremely (1 = Dislike Extremely, 2 = Dislike Very Much, 3 = Dislike Moderately, 4 = Dislike Slightly, 5 = Neither Like Nor Dislike, 6 = Like Slightly, 7 = Like Moderately, 8 = Like Very Much, 9 = Like Extremely). Participants cleaned their palates between samples with blank that provided. This study was approved by Research Ethic Committee of the Universiti Teknologi MARA.

2.6 Statistical Analysis

All data were scientifically analysed by using Statistical Package Social Science 21 (SPSS 21). Data from fibre determination of papaya peel flour and wheat flour was analysed by using t-test. Meanwhile, both data from proximate analysis and sensory evaluation test were analysed by using Analysis of Variance (ANOVA).

ANOVA was used to establish the significant differences between means followed by post hoc test. All of data were expressed as mean values ± standard deviation (SD). Each result was present with superscript and different superscript indicates the result is significant. Values of $p<0.05$ were regarded as statistically significant.

3. RESULTS AND DISCUSSION

3.1 Comparison of Crude Fibre in Papaya Peel Flour and Wheat Flour

Dietary fibre is a carbohydrate parts which cannot be hydrolysed by the endogenous enzyme in human small intestines. It have been shown to have a physiological effect of health benefit including reduce risk of type 2 diabetes, cardiovascular disease and cancer [24]. Thus, by using additional functional ingredient, this can help to develop a new product that can be commercialized as source of fibre. To develop the formulation of the product, the fibre content of the papaya peel flour need to be acknowledged. Table 2

shows the result of crude fibre content in papaya peel flour and wheat flour. The average percentage of crude fibre in 100 g of papaya peel flour is 12.24 ± 1.24%. Meanwhile, in wheat flour, the crude fibre content is 1.59 ± 0.02%.

Table 2: Fibre Determination of Papaya Peel Flour and Wheat Flour

Type of Flour	Fibre Determination
PPF	12.24 ± 1.24^{a}
WF	1.59 ± 0.02^{b}

Values are mean ± standard deviation
Mean in the same column with different letter differ significantly (p<0.05)
PPF-Papaya peel flour, WF-Wheat flour

These results suggested that papaya peel flour contain higher crude fibre content compared to wheat flour. Another study highlighted the use of papaya peel flour as a functional ingredient in food. In this study, it further stated the crude fibre content of papaya peel flour is 12.43%, which compared with papaya seed flour, 0.94% [25]. Based on study by Santos, Abreu, Freire, Queiroz, & Mendonça, (2014), total fibre of papaya peel from Havai species is 33.05%, while total fibre from Calimosa species is 34.70% [16]. Moreover, a study done by Chukwuka, Iwuagwu, & Uka (2013) also mentioned in their study that papaya peel at hard ripe stage contain 13.67% of crude fibre. Nonetheless, papaya peel at very ripe stage contain 9.67% of crude fibre which lower than hard ripe stage [26].

3.2 Proximate Analysis of Developed Pineapple Tart

Nutritional value of foods is an important part in food label due to the effect on human body as it relates to fat, cholesterol, and sugar intake. In order to identify the nutritional information of the food or product, proximate composition analysis can be done to acknowledge the food composition which includes moisture, ash, lipid, protein, carbohydrate and crude fibre content [27]. The analytical data of papaya peel formulated pineapple tart are shown in Table 3. One-way analysis of variance (ANOVA) was conducted to compare the nutrient content of three variations of pineapple tart samples. There is a significant difference between all the samples except for energy (kcal/100g) ($p<0.05$). This means all the samples different from each other in term of percentage of carbohydrate, protein, fat, moisture, ash and crude fibre.

Table 3: Proximate Analysis of Variation of Pineapple Tart

Variation of Samples	V1	V2	V3
Moisture	4.10 ± 0.02^{bc}	3.93 ± 0.04^{b}	2.66 ± 0.07^{a}
Protein	2.49 ± 0.00^{ab}	2.50 ± 0.00^{a}	2.47 ± 0.00^{b}
Fat	18.45 ± 0.00^{a}	19.90 ± 0.00^{b}	18.99 ± 0.00^{ab}
Ash	0.91 ± 0.02^{a}	1.25 ± 0.01^{b}	1.13 ± 0.06^{bc}
Total Carbohydrate	74.07 ± 0.04^{a}	72.43 ± 0.04^{b}	74.75 ± 0.01^{c}
Crude Fibre	3.62 ± 0.02^{a}	3.83 ± 0.02^{b}	4.10 ± 0.04^{c}

Values are mean ± standard deviation.
Mean in the same row with different letter differ significantly (p<0.05)
Key: V1 = Variation 0:100; V2 = Variation 4:96; V3 = Variation 10:90

The experimental results clearly showed the crude fibre content of three variations of pineapple tart were vary with each other. Among the three variations, V3 sample which contain the highest substitution of papaya peel flour contain the highest crude fibre content. This followed by V2 sample, which contain lower amount of papaya peel flour compared to V3. The lowest crude fibre content is V1 sample, with no substitution of papaya peel flour. Based on the result of this study, it has been proven that papaya peel can be utilized as functional ingredient to increase the fibre content in food product. Instead of being wasted and cause pollution to the environment, it can be added into variety of food product as new added value to consumer. Therefore, consume a healthy and delicious snack not only making the consumer happier, but it can also make the consumer healthier with the excellent health benefits provided.

3.3 Sensory Evaluation of Developed Pineapple Tart

Sensory evaluation is a scientific method that is used to measure and analyse products through five senses including sight, touch, smell, taste and hearing. It can be considered as one of parameters when determine consumer acceptance of a new development product. The participants' ratings of attribute in three variation of pineapple tart samples was calculated by using the one-way analysis of variance (ANOVA) and presented in Table 4. For appearance, the V1 received the highest average score of hedonic scale, which is 6.80 ± 1.61 followed by V2 (6.20 ± 1.61) and V3 sample (4.32 ± 1.77). Similarly, V1 sample (6.76 ± 1.59) received better response for colour attribute followed by V2 (6.08 ± 1.58) and V3 sample (4.00 ± 1.76). In term of appearance and color, the controlled pineapple tart sample received higher score among the three variations followed by V2 (variation 4:96) and V3 (variation 10:90). The appearance of formulated product is almost the same with the control, but it may differ in terms of colour. However, the V3 (variation 10:90) received mean score lower than 5 which means it is less acceptable in term of both appearance and colour. The colour of new developed pineapple tart samples were influenced by the yellow-to-orange colour of added papaya peel flour. Papaya peel flour are actually provide the natural colorant that comes from ß-carotene content in the papaya peel. Thus, there is no artificial colorant required to add into the dough to provide the same colour as the usual pineapple tart in the market. Nevertheless, the colour appeared darker after baking process and this is one of the factor contributed to the lower score. As the panel see three variation of samples in front of them, they can already predict the darker the product may contain differ ingredient added which can influence the evaluation.

In addition, the colour change after baking is a sure tip-off that Maillard reactions are happening due to additional sugars as part of ingredients. Both visual appearance and colour are important factors in consumer's food selection and colour can be considered as one of sensory properties that can easily affect the consumer opinions and can determines the first impression and rules the consumer's choice [28, 29]. The colour of food can affects the ability of consumer to correctly identify the flavour and to form distinct flavour profiles & preferences [30].

Table 4: Sensory Evaluation of Three Variation of Pineapple Tart Samples

Variation of Samples	V1	V2	V3
Appearance	6.80 ± 1.61^{ab}	6.20 ± 1.61^{b}	4.32 ± 1.77^{c}
Colour	6.76 ± 1.59^{ab}	6.08 ± 1.58^{b}	4.00 ± 1.76^{c}
Aroma	7.60 ± 1.23^{a}	6.36 ± 1.38^{b}	5.36 ± 1.55^{c}
Taste	7.48 ± 1.05^{a}	6.16 ± 1.49^{b}	3.76 ± 1.81^{c}
Texture	7.12 ± 1.20^{ab}	6.24 ± 1.20^{b}	5.08 ± 2.02^{c}
Overall Acceptance	7.44 ± 0.96^{a}	6.12 ± 1.24^{b}	3.96 ± 1.62^{c}

Values are mean ± standard deviation
Mean in the same row with different letter differ significantly ($p<0.05$)
Key: V1 = Variation 0:100; V2 = Variation 4:96; V3 = Variation 10:90

Furthermore, in term of aroma, the highest average score was the V1 sample (7.60 ± 1.225) followed by V2 (6.36 ± 1.381) and V3 sample (5.36 ± 1.551). Same goes to texture attribute, the V1 sample (7.12 ± 1.201) had the highest average score compared to V2 (6.24 ± 1.200) and V3 sample (5.08 ± 2.019). The controlled variation of pineapple tart received higher score in term of aroma, taste and texture followed by V2 and V3. For aroma and texture attribute, all of the sample from the three variation are acceptable as their mean score are higher than score 5. Conversely, V3 has the lowest score in term of texture, which make it less acceptable to be commercialized to the consumer. This can be influenced by the bitter aftertaste of the product after consumed which contributed by papaya peel flour. Therefore, the higher the papaya peel flour added, the bitter aftertaste will influenced the acceptability by consumer. The sense of smell is the key contributing sensory system in the perception food aromas and volatile flavours. By using sight and smell in the presence of food, this can stimulate appetite in anticipation of food consumption [31]. Moreover, the bite size of food that consumer eat also can affected by food aroma. A study by de Wijk, Polet, Boek, Coenraad, & Bult, (2012) stated that a higher aroma intensities would lead to smaller bite sizes and vice versa.

As V3 contain the highest amount of papaya peel flour, it may influence the aroma attribute to the end-product. Similarly, the texture of the food also plays an important role in consumer acceptance. The ingredients used in food can influenced the texture of the end-product. In pineapple tart, the proportion amount of wheat flour and papaya peel flour used may influence the texture. Papaya peel flour does not contain gluten that provide the strength and elasticity in dough. Thus, in the developed pineapple tart that contain less wheat flour and substitution of papaya peel flour may produce a dough that less springy. The tart produced were softer than the control pineapple tart and the crust may fall apart in hands. So, the consumer need to consume the whole of pineapple tart instead of having small bite. Therefore, it can be concluded that the texture differences in different pineapple tart are likely influenced the overall preference.

The overall acceptance of the pineapple tart as source of fibre was observed once all the observations had been done. The highest average score was V1 sample (7.44 ± 0.961) compared to V2 (6.12 ± 1.236) and V3 sample (3.96 ± 1.620). The results of overall acceptability were correlated with all the sensory attribution tested. It can be concluded that both V1 and V2 were generally accepted by the panellist. Thus, V2 has the highest potential to be commercialized as it was received well by the consumers. Nevertheless, V3 was less acceptable by the panellist which may be due to taste, appearance, colour and texture which influenced the overall acceptance.

4. CONCLUSION

This study provided information regarding nutrient analysis of the developed pineapple tart as source of fibre, compared with the control pineapple tart. One of the main ingredient that makes it different between variations is the substitution of papaya peel flour with wheat flour. All the results in proximate analysis shown were significantly different ($p<0.05$) except for energy (kcal/g). The developed pineapple tart can be considered as source of fibre as it contains fibre more than 3g/100g of sample. For overall, the consumer preferred V2 (Variation4:96) rather than V3 (Variation 10:90). It can be considered acceptable as all the mean score was more than 5. All the attributes were significantly difference ($p<0.05$) including appearance, colour, aroma, texture and overall acceptance. Thus, V2 (Variation4:96) of pineapple tart sample can be accepted and considered as source of fibre which provides health benefits to consumer. It has the highest potential to be commercialized in the food industry.

As the papaya peel flour has a slight of bitter aftertaste, it is recommended for future research to perform de-bitter process of the papaya peel flour before including it as part of the ingredient. This process should be done in order to remove the bitter taste from papaya peel flour. Therefore, the percentage of papaya peel flour being substituted can be increased. In the meantime, the fibre content of the product should be increased until it can be considered as high fibre product. The second recommendation for future research is to improvise the method of drying for papaya peel. In this study, the temperature used in the method may cause other nutrient loss such as vitamins and minerals. Therefore, it is recommended to improve this method to increase the fibre content while maintaining the availability of other nutrients.

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