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EFFECT OF BLANCHING METHODS ON THE PROXIMATE COMPOSITION AND BIOACTIVE COMPOUNDS OF FLOURS FROM DIFFERENT PUMPKIN PARTS AND THE SENSORY ACCEPTABILITY OF COMPOSITE-FLOUR SOUP

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ABSTRACT

Pumpkin (*Cucurbita pepo*), commonly known as '*Malenge*' is a climate-resilient crop commonly grown in Kenya. However, its use has been narrowed down to complementary feeding, utilizing only the pumpkin pulp and leaving out the nutrient-dense peels and seeds during flour formulation. This study aimed to promote the use of all pumpkin parts in flour formulation by determining the effect of microwave blanching and water blanching on moisture content, ash content, ascorbic acid, total carotenoids, and sensory properties of flour from the peels, pulp, and seeds. The pumpkin parts were prepared by water and microwave blanching before drying in a hot air oven at 60ºC and milling. The samples were analyzed for moisture and ash content by the muffle furnace method, while ascorbic acid content and total carotenoid content by the Ultraviolet-Visible Spectroscopy (UV-VIS) method. Sensory evaluation of pumpkin soup was determined by panelists using a 9-point hedonic scale. The sensory parameters of interest were color, taste, mouthfeel, consistency, and overall acceptability. The moisture content levels ranged from 4.95 % to 9.64 % while ash content ranged from 4.22 % to 4.99 % in the samples. The results indicated that moisture content was significantly lower for microwave-blanched samples compared to the unblanched and water-blanched samples. The ash content level was not significantly different between the unblanched and blanched samples for the different pumpkin parts. The unblanched pumpkin seeds contained the highest ascorbic acid content at 86.91 mg/100 g ± 0.10 mg/100 g, followed by pulp at 73.60 mg/100 g ± 1.15 mg/100 g and peels at 68.34±3.71 mg/100 g. However, ascorbic acid content was significantly reduced with water blanching compared to microwave blanching. For carotenoid content, the range was 30.80 mg/100 g to 35.73 mg/100 g, 25.11 mg/100 g to 33.51 mg/100 g, and 7.35 mg/100 g to 12.28mg/100g for the pulp, peels, and seed samples, respectively. The carotenoid content increased significantly with water blanching and microwave blanching for pumpkin peels and pulp probably due to increased ease of extractability. The sensory evaluation of the soup showed significant differences ($p<0.05$) between the microwave-blanched and unblanched soup in taste, mouthfeel, consistency, and overall acceptability. Therefore, blanching is recommended in value-added composite flour production to promote utilization of pumpkin peels, seeds, and pulp, providing a sustainable solution to reduce waste and increase consumption.

Key words*:* Pumpkin seeds, peels, pulp, blanching, ascorbic acid, carotenoids, microwave, sensory

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INTRODUCTION

The triple burden of malnutrition continues to be a major concern among low- and middle- income countries, creating a dependency on supplementation programs [1]. Countries like Kenya are well known for their vast and fertile agricultural land, which is capable of preventing undernutrition within its population. For instance, approximately 85% of the rural population in Kenya derives their livelihood from farming and related practices [2].

There has, however, been a reduction in area under production due to changes in rainfall patterns associated with climate change. For instance, according to the Economic Survey in Kenya [3], the crop production sector as of 2021 had undergone a contraction of 0.4% in 2021 and a further contraction of 1.6% in 2022. There is a need to utilize locally available and drought-resistant crops in the fight against malnutrition instead of relying on foreign aid to ensure sustainability [4].

Pumpkins (*Cucurbita moschata* and *Cucurbita pepo*) are the most grown species for human consumption across the world, whereas the cultivar *Cucurbita pepo,* locally known as *Malenge* is the one widely grown in Kenya [2]. Pumpkin pulp, peels, and seeds contain a considerable amount of micronutrients that can help fight against hidden hunger. Despite their nutrient composition, most households consume pulp alone, discarding the peels and the seeds due to their associated anti-nutrient composition that binds to the minerals present in them [2].

However, recent research [4] showed the effectiveness of microwave blanching and water blanching in the reduction of anti-nutrient composition of pumpkin peels and seeds. There is limited information on the effect of microwave blanching and water blanching on other micronutrients of concern and sensory properties of the flour produced from the blanched pumpkin parts. This research looked into the effects of microwave blanching and water blanching on ash content and moisture content, ascorbic acid content, total carotenoid content of the pumpkin parts, and the sensory properties of the composite flour from the differently blanched pumpkin parts.

MATERIALS AND METHODS

Research design

This study employed a 3×3 factorial experimental design involving two independent factors: pumpkin part and blanching method. The pumpkin parts comprised three levels (peels, pulp, and seeds), while the blanching methods comprised three levels (unblanched /control, microwave blanching, and hot water blanching). This produced nine treatment combinations, each evaluated in triplicate (N = 27). The response variables measured for each combination included moisture content, ash content, ascorbic acid content, total carotenoids, and sensory acceptability of the resulting composite-flour soups.

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Sample collection and preparation

Mature pumpkin fruits were obtained from Dedan Kimathi University of Technology Farm in Nyeri using a simple random sampling technique. They were then washed thoroughly and separated into the pumpkin peels, pulp, and seeds. The peels and pulp were sliced into 2 × 3 inches using a knife and weighed to obtain 1.5 kg of pulp, peels, and seeds, and then subjected to the various treatments. The samples were then divided into three portions; one portion of the pulp, peels, and seeds was used as a control, and the remaining two were subjected to blanching. Water blanching was performed at 93 °C for 120 s, and microwave blanching was performed using a 700 W microwave (Ramtons 700 W output RM 237, Kenya) for 120 s. The samples were then run under cold water for 1 min and placed on blotting paper to drain. The samples were placed in the hot air oven (RKC Instrument Inc. Model UDO-101-3, UK) at 60 ºC for 49 hours until all parts were brittle. The samples were then ground using a spice grinder of 220V 3400 r/min (Zhejiang Boou Electric Company Limited, Model Number 800Y, China), sieved through a 250 microns sieve, and stored in labeled Ziploc propylene bags at room temperature awaiting chemical analysis.

Determination of moisture content

The moisture content of the flours was determined using the hot air oven method described by Nielsen [5]. Five (5) grams of each flour sample was measured and placed in an oven at 105 °C for 3 h and then placed in a desiccator. The weights were measured after cooling and recorded. The measurements were performed in triplicate, and the mean weights were calculated using the following equation:

$$\% \text{ Moisture content} = \frac{\text{weight before drying} - \text{weight of sample after drying}}{\text{weight of sample before drying}} \times 100$$

Determination of ash content

The ash content of the flour was determined using the dry ashing method described by Nielsen [5] with minor adjustments. Approximately 5 g of each flour sample was weighed into the respective crucibles, and the weight of the crucible plus the sample was recorded. The crucibles were placed in a muffle furnace at 550 °C for 5 h, then switched off and allowed to cool. The crucibles were removed from the muffle furnace and placed in a desiccator to cool. The crucibles were then weighed, and the following formula was used to determine the ash content:

$$\text{Weight of ash} = (\text{weight of crucible and ash}) - \text{weight of crucible}$$

$$\% \text{ Ash} = (\text{weight of ash} / \text{original sample weight}) \times 100$$

Determination of ascorbic acid content

To determine the amount of ascorbic acid in pumpkin part flours, the spectroscopy method described by Hagos [6] was used. A stock solution of 1000 ppm was prepared by dissolving 100 mg of ascorbic acid in 100 mL of distilled water. Serial

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dilutions were made to obtain 1, 3, 6, 9, and 12 mg/L as the working standard solutions, which were then run through ultraviolet–visible spectroscopy to obtain the values for the generation of the absorption spectrum. The maximum absorption peak was 260 nm, which was used to read the sample values. For sample preparation, 0.2 g of pumpkin flour samples were weighed and dissolved in 15 mL of distilled water and placed over a vortex mixer for 20 min to facilitate the extraction of ascorbic acid from the sample matrix. The mixture was then filtered using Whatman Filter Paper Grade 42, and the filtrate was transferred into centrifuge tubes and centrifuged at 4000 rpm for 10 min at room temperature. The supernatant was then obtained and placed in a sample cuvette, and the absorbance was read at 260 nm. The regression equation obtained from the standard curve was used to calculate the ascorbic acid content of the samples, expressed as mg/100 g.

Regression equation used: $y = 0.0392x + 0.1279$ ($R^2 = 0.9901$)

where y is the absorbance value, and x is the compound content.

Determination of total carotenoids content

The total carotenoid content was determined using a recently used process [7] with some modifications. The experiment was done in dim light to avoid degradation of the carotenoids. Each pumpkin part powder of 5 g was placed into a mortar, and acetone was added as the sample was ground. The carotenoids were extracted gradually through the addition of 50 mL of cold acetone. The mixture was then transferred through a funnel with filter paper into a 50 mL volumetric flask and washed with acetone until the filter paper was devoid of any color. The solution was then topped up to the mark. Then, 50 mL of hexane was placed in a separating funnel, and the extract with acetone was added slowly to the separating funnel. Distilled water was then added to the neck to remove acetone. 5 min were given to allow the phases to separate. The lower aqueous layer was then removed and discarded. More distilled water was added to wash away the acetone. The sample with hexane was washed four times with distilled water until the solution turned colorless. The organic phase was then collected in a conical flask through a funnel containing 15 g anhydrous sodium sulfate. The sample was then read at 450 nm using a spectrophotometer, and values were determined as mg/100 g of pumpkin powder.

Sensory evaluation

Pumpkin soup was prepared from the composite flour of dehydrated pumpkin pulp, peels, and seeds. The use of the composite was to actualize the utilization of the whole pumpkin fruit. The soup preparation was done according to previous research [8] with some modifications. To make the composite flour, 70 % of pulp flour was mixed with 15 % peels and 15 % seeds flour. One hundred grams of the composite flour was mixed with 950 mL of potable water at room temperature and cooked over

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medium heat for 20 min while being stirred. Three soup samples of 20 mL-25 mL each were served in coded transparent plastic sauce cups and placed in coded saucer plates along with mini-tasting spoons and potable room temperature water for palate cleansing in between tastings. The panel evaluated the soup samples for color, taste, mouthfeel, consistency, and overall acceptability [9]. Fifty panelists comprising of 34% (n=17) females and 66% (n=33) males of an average age of 22.28 years (standard deviation of 5.49) were recruited to participate in the sensory evaluation activity through an advert placed on the notice boards around the university and shared through social media platforms a week before the activity. The sensory evaluation activity was conducted at the food workshop at Dedan Kimathi University. A 9-point hedonic scale tool was used for sensory evaluation of the pumpkin soup from the differently blanched pumpkin parts flours (*9-like extremely, 1-dislike extremely)*. To ensure a completely randomized design in the sensory evaluation, the soup samples were presented to the panelists in a randomized order after allocation of a computer-generated three-digit random number for labeling of the cups and plates [10]. The panelists recorded their responses on questionnaires provided.

Data analysis

The data obtained were analyzed using Minitab Release 18 Software (Minitab Inc., Pennsylvania, USA). The data underwent preliminary testing to check for adherence to statistical assumptions: normality was assessed using the Anderson-Darling test, and homogeneity of variances was assessed using Levene's test. Considering pumpkin parts and blanching methods as sources of variation, the data were subjected to two-way analysis of variance (ANOVA), and the means were considered significantly different at $p< 0.05$. The results were expressed as the mean ± standard deviation (SD). Fisher's least significant difference (LSD) was used to separate the means to identify those that showed significant differences.

Ethical consideration

Ethical clearance for this study, including the protocols for human sensory evaluation, was reviewed and approved by the Dedan Kimathi University of Technology Scientific Ethics Review Committee (DeKUT-SERC) under the License Number DeKUTSERC/CA/03422/089. The research was authorized by the National Commission for Science, Technology, and Innovation (NACOSTI) through License Number NACOSTI/P/24/41320.

RESULTS AND DISCUSSION

Moisture content

The results showed that the moisture content of seeds was lower than that of the pulp and peels, ranging between 4.95% and 5.81%, while that of the peels ranged from 7.47% to 8.76% and that of the pulp ranged from 6.24% to 9.64% (Table 1).

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The moisture content was similar to that reported in the literature. A level of 5.53% was reported in seeds, while moisture content levels of 7.53% to 8.58% have also been observed [11, 12]. The highest moisture content noted in the samples was 9.64%; however, it was below the 15% maximum tolerable moisture level in flour [13].

A two-way analysis of variance (ANOVA) was conducted to evaluate the main and interaction effects of pumpkin part and blanching treatment on moisture content (N = 27). The analysis revealed highly significant main effects for both pumpkin part ($p < 0.001$) and blanching treatment ($p < 0.001$). Furthermore, a significant two-way interaction effect was observed between pumpkin part and blanching treatment ($p < 0.001$). This interaction indicates that the effect of blanching on moisture content varies significantly depending on the specific pumpkin part being processed.

The moisture content of the pumpkin peels was significantly higher than that of the other parts, which could be attributed to the compact cellular structure in the peels, which leads to higher water retention than in the pulp and seeds [14]. Additionally, the cutinized waxy outer layer of the peel is designed to reduce evaporation. Microwave-blanched samples showed significantly lower moisture content in all parts of the pumpkin than water-blanched samples. This could be attributed to the microwave radiation capability to improve the effectiveness and efficiency of drying, among other quality attributes, as a pre-treatment method in drying techniques for pumpkin [15]. Additionally, water blanching involved exposure of the parts to hot water, leading to a higher initial moisture content than that of the unblanched and microwave-blanched samples. Blanching as a pre-treatment method has been reported to be an effective way to improve mass transfer, thereby accelerating the drying process in foods [16].

Ash content

The ash content in seeds ranged from 4.22% to 4.41%, in pulp 4.63% to 4.99% and in peels 4.45% to 4.66% (Table 2). The ash content in the blanched samples of the peels, pulp and seeds was not significantly different from their unblanched counterparts. This shows that blanching does not significantly reduce the inorganic nutrition profile in the various pumpkin parts. Additionally, this demonstrates that the pumpkin peels, pulp and seeds all contain a considerable amount of minerals. The results of this study on the ash content of the different parts of pumpkin were higher compared to those reported by other authors. Research reported a range of 2.75% and 3.38% in seeds, [17] while a range of 1% - 2.5% was reported in the pulp of various pumpkin cultivars grown in Kenya [18]. On the other hand, the ash content from this study was also considerably lower compared to those of 6.04% and 10.17% for the peels and pulp, respectively reported by previous research [19]. The difference in the ash content could be attributed to the difference in environmental

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and agronomic conditions for the growth of the pumpkins involved in the studies [20]. The ash content of the pumpkin seeds (4.41%) is relatively higher compared to other seeds such as sesame seeds (3.10%) and within the range of 3.6% - 7.8% associated with chia seeds [21, 22]. The slight reduction of ash content in the blanched samples is attributed to the possibility of leaching. During application of blanching as a pre-treatment method, leaching of nutrients can occur [23].

A two-way analysis of variance (ANOVA) was conducted to determine the main and interaction effects of pumpkin part and blanching treatment on ash content (N = 27). The analysis revealed a statistically significant main effect for pumpkin part ($p = 0.027$). In contrast, the main effect of blanching treatment was not statistically significant ($p = 0.196$), nor was the two-way interaction between pumpkin part and blanching treatment ($p = 0.687$). These findings indicate that while initial ash content differs significantly across the different pumpkin parts, blanching treatments do not cause significant alteration to the total ash content, regardless of the part processed.

Ascorbic acid content

The results showed significant differences in ascorbic acid content of the peels, pulp and seeds, with the seeds containing the highest content followed by the pulp and then the peels (Table 3). A two-way analysis of variance (ANOVA) was conducted to evaluate the effects of pumpkin part, blanching treatment, and their interaction on ascorbic acid content (N = 27). The main effects were statistically significant for both pumpkin part ($p < 0.001$) and blanching treatment ($p = 0.001$). Additionally, a highly significant two-way interaction effect was observed between pumpkin part and blanching treatment ($p < 0.001$). This interaction demonstrates that the magnitude of ascorbic acid retention or degradation following blanching is strongly dependent on the specific tissue type of the pumpkin part processed.

The ascorbic acid content for the unblanched pumpkin parts was higher than the values provided in research conducted in Ethiopia, where the levels were 37.6 mg/100 g, 34.4 mg/100 g, and 36.4 mg/100 g for pumpkin peel, flesh, and seeds, respectively [24]. The unblanched samples showed significantly higher levels of ascorbic acid than the blanched samples. This indicates that blanching affects the levels of ascorbic acid in the pumpkin parts, which could be attributed to the instability and vulnerability of ascorbic acid to destruction in processing.

Water-blanched samples showed significantly lower levels than the microwave blanching method. This could be attributed to the solubility of ascorbic acid in water, leading to loss during the water blanching process [25]. Additionally, the lower levels can be attributed to the vulnerability to destruction with exposure to increased temperatures above 60°C [26]. Therefore, microwave blanching ensures better ascorbic acid retention in pumpkin parts compared to water blanching. This agrees with research conducted on the effect of microwave blanching on nutrient retention,

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which showed that there is 50 % retention of ascorbic acid in foods when a 300 W microwave is used for 3 min [27]. The higher retention of ascorbic acid, by at least 70% in this study, may be attributed to the reduced exposure time by 60 s in the microwave.

Total carotenoids content

The carotenoid content of the pumpkin parts ranged from 7.35 mg/100 g to 35.93 mg/100 g (Table 4). A two-way analysis of variance (ANOVA) was conducted to evaluate the main and interaction effects of pumpkin part and blanching treatment on total carotenoid content (N = 27). The main effects were highly significant for both pumpkin part ($p < 0.001$) and blanching treatment ($p < 0.001$). A significant two-way interaction effect was also observed between pumpkin part and blanching treatment ($p < 0.001$). The presence of a significant interaction demonstrates that the impact of thermal processing on carotenoid retention or release varies depending on the structural matrix of the specific pumpkin tissue.

Therefore, the total carotenoid content was significantly higher in the unblanched seed samples than in the blanched samples. The reduction may be attributed to loss of the carotenoids during blanching. This is because, when exposed to heat during blanching, carotenoids are vulnerable to oxidation and degradation, resulting in a reduction in their content [28, 29]. The blanched samples, on the other hand, had higher levels of carotenoids than the unblanched pulp and peel samples, which may be attributed to increased extractability during laboratory analysis. According to studies on Kintoki carrots, fenugreek leaves, and ivy gourd, there was an increased carotenoid content in water-blanched samples, which was associated with the softening of tissues associated with blanching, thus increasing the permeability of plant cells [30, 31]. The destruction of cell walls due to thermal exposure during blanching allows for the easier extraction of carotenoids during laboratory analysis [32]. Additionally, because of the association between blanching and enzyme deactivation, blanching leads to the inactivation of enzymes responsible for the destruction of carotenoids, thereby increasing their stability and preventing losses during processing [30].

Sensory evaluation

Parameters evaluated include color, taste, mouthfeel, consistency, and overall acceptability as presented in Table 5.

Color

The results indicated a significant difference ($p<0.05$) in the color of the soup between the unblanched sample and the water-blanched samples. The soup formulated from the water-blanched pulp, peels, and seeds was the most preferred by the panel. This could be attributed to the brighter and more appealing shade of orange color in the soup compared to the microwave-blanched and unblanched

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samples. This is similar to findings from research on Chinese kale that showed a brighter green color achieved from water blanching compared to the unblanched samples [33]. According to a study done on the effect of different blanching methods on peas showed that water blanching resulted in a darker shade of green compared to microwave blanching [34]. Additionally, water blanching is seen to slightly lead to a darker hue in tomatoes and carrots [34, 35]. Research on pumpkin also showed that blanching leads to the darkening of the pulp color in some pumpkin varieties [36]. The slight color change is attributed to the inactivation of lipoxygenase enzyme that prevents the oxidation and the degradation of the color of pumpkin when exposed to high temperatures for a short time enough to cause a slight change in color [36]. The results from the panel contradict previous studies on asparagus and broccoli which showed better green color retention among microwave-blanched samples then among hot water and steam blanched samples [34].

Taste

The soup that was highly rated in terms of taste was formulated using water-blanched dehydrated pumpkin parts (Table 5). However, there was no significant difference between the water-blanched and unblanched samples. This indicates that the taste of the soup was similar to that of the unblanched counterpart. This result agrees with that of Begum and Brewer [35], who showed that blanched tomatoes retained the same sensory quality as unblanched tomatoes. However, the soup formulated from microwave-blanched samples showed a significant difference from that of the unblanched samples. This contradicts research on snow peas, which showed that microwave-blanched snow peas retained similar sensory quality to unblanched snow peas [37].

Mouthfeel

The soup formulated from the unblanched pumpkin parts was the most preferred in terms of mouthfeel. A significant difference was observed between the mouthfeel of soup formulated with unblanched samples and that formulated with microwave-blanched samples. The panelists associated the mouthfeel of the soups with a gritty/grainy mouthfeel, which could be attributed to the insoluble fiber present in pumpkin peels and seeds. This is in agreement with the sensory evaluation conducted on soup formulated from cow pea flour and pumpkin seed flour, where panelists reported the soup to have a grainy mouthfeel, which was attributed to the fiber content of the pumpkin seed coat [8]. Pumpkin peels also contain considerable amounts of cellulose and hemicellulose. The peels contain approximately 80 % fiber, with insoluble fiber being the main type of fiber constituent [38]. Research on oat bran showed that the insoluble fiber present in oat bran resulted in distinct particle perception that panelists described as a sandy or gritty mouthfeel [39].

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Consistency

The soup that was formulated from unblanched pumpkin parts, rated at 6.51 ± 1.71, had the most preferred consistency. However, there was no significant difference in the consistency of pumpkin soup prepared from blanched dehydrated pumpkin parts compared to that prepared from unblanched and dehydrated pumpkin parts. Previous research on Chinese kale and purple sweet potato flour showed that the consistency of soup from unblanched and blanched samples had no significant difference [33]. The consistency of the soup is more dependent on the reconstitution of flour with water and the water absorption capacity of the flour, which is not affected during blanching [33].

Overall Acceptability

The soup formulated from unblanched and dehydrated pumpkin parts had the highest overall acceptability. However, there was no significant difference between the overall acceptability of the soup made from unblanched pumpkin parts and that made from water-blanched pumpkin parts. The soup formulated from the microwave-blanched samples was the least preferred and was significantly different from the unblanched and water-blanched soups. The lower overall acceptability of the microwave-blanched samples shows an accurate rating, considering that it was also the least preferred in the other parameters (color, taste, and mouthfeel). This contradicts research that found that microwave blanching increased the overall sensory quality and acceptability in carrots and asparagus, respectively, but, different foods react differently to microwave blanching, which may result in contradictory findings [40].

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

Microwave blanching resulted in a lower moisture content than water blanching. However, the ash content was not affected by the blanching methods for any of the pumpkin parts. The L-ascorbic acid content was reduced in both methods, with water blanching having a greater effect than microwave blanching. Blanching methods increased the extractability of total carotenoids in pumpkin peels and pulp. Sensory quality attributes such as taste, mouthfeel, consistency, and overall acceptability of pumpkin soup were not affected by water blanching. Through the utilization of various pumpkin parts, highly nutritious products can be developed, preventing pumpkin post-harvest loss and waste and combating micronutrient deficiencies. Further research needs to be conducted on in vivo and in vitro studies to understand the bioaccessibility and bioavailability of the nutrients in the various pumpkin parts.

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CONFLICT OF INTEREST

The authors report no conflict of interest.

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Table 1: The level of Moisture content (%) of the differently blanched and dehydrated pumpkin parts.

	Unblanched	Microwave Blanched	Water Blanched
Seeds	5.51±0.19^{f}	4.95±0.00^{g}	5.81±0.06^{f}
Pulp	6.88±0.32^{d}	6.88±0.32^{d}	9.64±0.27^{a}
Peels	8.76±0.19^{b}	7.47±0.33^{c}	7.90±0.27^{c}

Note: Values are expressed as mean ± standard deviation. The means sharing the same lowercase letters in rows are not significantly different from each other. Mean separation was done using Fisher's LSD (p <0 .05)

Table 2: The level of Ash content (%) of differently blanched and dehydrated parts

	Unblanched	Microwave Blanched	Water Blanched
Seeds	4.41±0.15^{bc}	4.22±0.07^{c}	4.35±0.27^{c}
Pulp	4.99±0.10^{a}	4.63±0.06^{ab}	4.89±0.14^{a}
Peels	4.66±0.21^{ab}	4.59±0.26^{abc}	4.45±0.10^{bc}

Note: Values are expressed as mean ± standard deviation. The means sharing the same lowercase letters in rows are not significantly different from each other. Means separation was done using Fisher's LSD (p <0 .05)

Table 3: Ascorbic acid content (mg/100g) of the differently blanched and dehydrated pumpkin parts

	Unblanched	Microwave Blanched	Water Blanched
Seeds	86.91 ±0.10^{a}	60.87 ± 7.65^{d}	51.36 ± 2.50^{e}
Pulp	73.60 ±1.15^{b}	70.61 ± 6.20^{b}	61.58±1.43^{cd}
Peels	68.34±3.71^{bc}	61.34 ± 1.36^{cd}	52.60 ± 6.62^{e}

Values are means ± standard deviation. The means sharing the same lowercase letters in rows are not significantly different from each other. The means' separation was done by fisher's LSD (p <0 .05)

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Table 4: Total Carotenoid content (mg/100g) of the differently blanched and dehydrated pumpkin parts

	Unblanched	Microwave Blanched	Water Blanched
Seeds	12.28±0.03^{f}	9.50±0.14^{g}	7.35±0.36^{h}
Pulp	30.80±0.18^{c}	35.93±0.67^{a}	35.73±0.29^{a}
Peels	25.11±0.51^{e}	26.96±0.05^{d}	33.51±0.38^{b}

Note: Values are expressed as mean ± standard deviation. The means sharing the same lowercase letters in rows are not significantly different from each other. Means separation was done using Fisher's LSD (p <0 .05)

Table 5: Mean sensory scores of the sensory evaluation of pumpkin soup developed from pumpkin parts composite flour

Parameters	Samples		
	Unblanched	Microwave Blanched	Water Blanched
Color	6.72 ± 1.54^{b}	6.16 ± 1.84^{b}	7.94 ± 0.99^{a}
Taste	6.43 ± 1.84^{a}	5.31 ± 1.84^{b}	6.27 ± 1.97^{a}
Mouthfeel	6.51 ± 1.75^{a}	5.51 ± 1.89^{b}	6.25 ± 1.95^{ab}
Consistency	6.51 ± 1.71^{a}	5.80 ± 1.97^{a}	6.41 ±1.96^{a}
Overall Acceptability	6.65 ± 1.48^{a}	5.65 ± 1.74^{b}	6.55 ± 1.62^{a}

Note: Values are expressed as mean ± standard deviation. The means sharing the same letters in rows are not significantly different from each other (p <0 .05). The composite flour consisted of 70% pulp flour, 15% peel flour, and 15% seed flour. (Hedonic scale: 9-like extremely, 1-dislike extremely; n=50)

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