

*Full Length Research Paper*

# **Quality and sensory properties of instant fried noodles made with soybean and carrot pomace flour**

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Wheat flour commonly used in making noodles is rich in starch but poor in protein and fiber. Wheat flour substituted with soybean and carrot pomace flours were used to produce instant fried noodles. Soybean is high in protein while carrot pomace is rich in dietary fiber. The aim of this study was to evaluate the effect of substituting wheat flour with soybean and carrot pomace flour on the physicochemical, cooking and sensory properties of instant fried noodles. Four flour blends in ratios of 100:0:0, 80:15:5, 70:20:10, 60:25:15 wheat, soybean and carrot pomace flour respectively were prepared. The results indicated a significant difference ( $P < 0.05$ ) in protein and crude fiber content of the noodles made from the flour blends. The cooking loss and water absorption increased with increase in the amount of substituted soybean and carrot pomace flour. There was no significant difference in the tensile strength among noodles. However, breaking length of the noodles decreased with increase in replacement of soybean and carrot pomace flour. The noodles decreased in brightness with increased carrot pomace substitution. Noodles made from 80% wheat flour, 15% soybean flour and 5% carrot pomace were the most preferred by the sensory panelist. Incorporation of soybean flour and carrot pomace flour improved the nutritional quality and sensory attributes of the instant fried noodles.

**Key words:** Instant fried noodles, carrot pomace flour, soybean flour.

## **INTRODUCTION**

Consumption of noodles has increased worldwide because of their convenience, palatability, shelf stability and affordability. Noodles are pasta products mainly made from flour, water, salt. The properties of the flour, type of salt and the manufacturing process leads to a wide array of noodles types (Fu, 2008; Gulia et al., 2014). Noodles are mainly made by a process of mixing raw materials, dough sheeting, compounding, sheeting / rolling and cutting. Noodle strands coming out of cutting

rolls are further processed to produce different types of noodles (Fu, 2008; Gulia et al., 2014; Adejuwon et al., 2020). Two types of noodles are generally known, white salted noodles made from flour, sodium chloride and water, and yellow alkaline noodles made from flour, alkaline salts (sodium tripolyphosphate and sodium carbonate) and water (Asenstorfer et al., 2006; Siah and Quail, 2018).

Wheat flour used in making noodles is rich in starch but

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low in protein (essential amino acids especially lysine), dietary fiber and vitamins which are lost during wheat flour refinement (Dewettinck et al., 2008). Previous studies have tried solving this problem by substituting wheat flour with various foods rich in protein and fiber. These includes substituting wheat flour with potato flour (Kang et al., 2017), soy flour (Rani et al., 2019), seaweed flour (Kumoro et al., 2016), lentil (Rathod and Annapure, 2017), ground linseed (Zhu and Li, 2019), apple pomace (Xu et al., 2020), carrot puree (Prerana and Anupama, 2020), finger millet (Hymavathi et al., 2019) and oyster mushrooms (Arora et al., 2018). Limited studies have incorporated soybean flour together with carrot pomace in the noodles. Soybean flour provides extra protein while carrot pomace provides fiber and beta carotene to the wheat flour noodles.

Soybeans are excellent sources of protein (35-40%), rich in calcium, iron, phosphorous and vitamins (Udachan et al., 2018). Noodles made mainly from wheat flour are rich in carbohydrates but are deficient in terms of protein quality and amino acid (Udachan et al., 2018). Incorporation of soybean flour seeks to improve the protein quality of noodles. Several studies have successfully incorporated soy flour in noodles (Pakhare et al., 2016; Jalgaonkar et al., 2018; Huh et al., 2019; Rani et al., 2019, 2020; Violalita et al., 2020). Pakhare et al. (2016) reported a significant increase in protein content of noodles supplemented with defatted soy bean flour. Cooking loss and cooking time of the noodles also increased significantly.

Carrot has gained increased attention over the years due to its richness in antioxidants and beta carotene (pro-vitamin A) (Sharma et al., 2012). Carrot pomace is the by-product of carrot juice extraction unit. During carrot juice production, 30-50% of the carrot remains as pomace, and up to 50% of the carotene is lost with the pomace (Sharma et al., 2012). The pomace is mainly disposed as feed or manure, however, it contains a good residual amount of all the vitamins, minerals and dietary fiber (Surbhi et al., 2018). Incorporation of carrot pomace in food will decrease its environmental load problem. Various attempts have been made at utilizing carrot pomace in foods such as cookies (Ahmad et al., 2016; Sahni and Shere, 2017), cake (Majzoobi et al., 2016; Semwal et al., 2016), sausage (Yadav et al., 2018) and pasta (Jalgaonkar et al., 2018).

The aim of this study was to evaluate the effect of incorporating different proportions of soybean flour and carrot pomace flour on nutritional composition, physical properties and sensory characteristics of instant fried noodles.

## MATERIALS AND METHODS

### Wheat and soybean flour

Commercial wheat flour was obtained from a local supermarket, defatted soy flour was obtained from Soy Africa Company, Kenya.

### Preparation of carrot pomace flour

Fresh carrots were purchased from a local market in Juja, Kenya. Pomace flour was obtained according to a method described by Gull et al. (2015). The carrots were washed in running tap water to remove extraneous material followed by juice extraction. Carrot pomace was collected, spread on aluminum foils and oven dried at 60°C for 4 h. The dried pomace was ground and packed in air tight container for further use.

### Formulation of composite flour

Wheat flour, soybean flour and carrot pomace flour were mixed at different proportions as shown in Table 1.

### Noodle production

The noodles were processed at Jomo Kenyatta University of Agriculture and Technology (JKUAT) Nissin Foods Limited. Recipe for making noodles was provided by JKUAT Nissin Foods. One kilogram of each flour blends (as shown in Table 1) were mixed separately with water (360 ml/kg), table salt (16 g/kg), sodium bicarbonate (2 g/kg) and sodium tri polyphosphate (2 g/kg) in a rotary mixer. A thick sheet of dough formed which was allowed to rest for 20 min in a plastic bag. The dough was then passed through extension rollers to reduce thickness. The thin sheet of dough produced was passed through a shredder. The shredded dough was then cut at 10 cm spacing, steamed for 20 min and deep fried at 140°C in palm oil for 30 s. The instant fried noodles were then cooled at room temperature and packed in airtight bags.

### Chemical analysis

#### Proximate analysis

Proximate analysis of instant fried noodles prepared from the different flour blends were determined using standard methods of AOAC (2010). Proximate analysis was done in triplicate to obtain a mean value for each nutrient.

#### Total carotenoid content

This was determined using AOAC (2010) method. About 2 g of each sample was weighed, transferred into a mortar and a 10 ml of acetone added. A pinch of acid washed sand was added and the sample was thoroughly ground using pestle until it produced no more color. The acetone extract was transferred into a 25 ml volumetric flask and topped up with acetone. The extract was transferred into a separating column and 25 ml of petroleum ether was added. The separating column was shaken vigorously then allowed to stand. The mixture separated into two, and acetone which is at the bottom was released from the column. Distilled water was added to wash off the acetone, this was done severally to completely wash off the acetone. After extraction, the total carotenoid content was determined using UV-Vis spectrophotometer (PD 3000UV APEL Co.) at 450 nm. Beta carotene standard curve was used to calculate the total carotenoid content. Results were presented as mg/100 g.

#### Mineral content analysis

Mineral content (calcium (Ca), magnesium (Mg), zinc (Zn) and phosphorous (P)) of the noodles were determined using atomic

**Table 1.** Quantity of wheat, soybean and carrot pomace flour blends prepared.

Flour blends	Wheat flour (%)	Soybean flour (%)	Carrot pomace (%)
Control	100	0	0
Sample A	80	15	5
Sample B	70	20	10
Sample C	60	25	15

absorption spectroscopy (AAS) (model 210 VPG) according to AOAC (2010) method. Absorbance was recorded and standard curves of each individual element were plotted. Results were expressed as mg/100 g sample.

### Carbohydrate content

The difference method was used to determine carbohydrate content of the noodles as follows:

% Carbohydrate = 100 - (% moisture content + % crude fibre + % ash content + % fat content + % protein).

### Physical measurements

#### Cooking time

This was determined by noticing the time of disappearance of the core of the noodle strand during cooking (every 30 s) by squeezing the noodles between two transparent glasses slides (Prerana and Anupama, 2020).

#### Cooking loss

This is the amount of solid substance lost into the cooking water and was determined according to the method described by Ritthiruangdej et al. (2011). Ten grams of the sample noodles was placed in 300 ml of boiling distilled water in a 500 ml beaker and cooked to optimum time. The cooking water was collected (thoroughly agitating the total cooking water before sampling) after draining the noodles. The cooking water was placed in aluminum vessel then placed in an oven at 105°C and evaporated to dryness. The residue was weighed and reported as percentage of the uncooked noodles.

$$\text{Cooking loss} = \frac{\text{Weight of remaining solid content after oven drying}}{\text{Weight of fresh noodles}} \times 100$$

#### Water absorption

Three grams of the sample noodles were boiled in 200 ml of water until completely cooked (when center of the noodles becoming transparent). The cooked noodles were washed with distilled water then drained for 5 min and weighed immediately. Water absorption was reported as percent increase in the weight of cooked noodles compared to the uncooked noodles weight (Takahashi et al., 2005).

$$\text{Water absorption} = \frac{(\text{Weight of cooked noodles} - \text{Weight of uncooked noodles})}{\text{Weight of uncooked noodles}} \times 100$$

### Color analysis

The color of uncooked noodles samples were measured using a Hunter Lab color analyzer. In the Hunter's lab colorimeter, the color of a sample is denoted by the three dimensions, L\*, a\* and b\*. The L\* value is a measurement of brightness (100 for perfect white to 0 for black, as the eye would evaluate it), a\* value represents the red-green coordinates (negative is green while positive is red), b\* value is the blue to yellow coordinates (negative is blue while positive is yellow). The L\*, a\* and b\* readings of the noodles were obtained directly from the instrument.

### Noodle texture analysis

Texture analysis of cooked noodles was measured using a Texture Analyzer (TA-XT2i) under optimal test conditions. Measurements were carried out at room temperature exactly ten minutes after cooking according to the method described by Lu et al. (2009). Instrument was set at break mode: test speed 1 mm/s. Two texture parameters were obtained tensile strength (maximum force; N) and breaking length (distance at maximum force).

### Sensory evaluation

All noodles samples were cooked to the optimum cooking time and served to 20 untrained panelist. Samples were coded with three-digit random numbers and served in random order. Parameters evaluated were aroma, taste, color, texture and overall acceptability using a 9 point hedonic scale, where 9 = like extremely and 1 = dislike extremely (Gunathilake and Abeyrathne, 2008).

### Statistical analysis

The means and standard deviations were determined for all the nutritional, textural, cooking and sensory qualities studied. The significant differences of mean values were assessed with one-way analysis of variance (ANOVA) followed by Duncan's test using SPSS software (Version 17.0 Inc.). Significant differences were determined at P<0.05.

## RESULTS AND DISCUSSION

### Proximate analysis

Chemical composition of instant fried noodles with supplemented soybean flour and carrot pomace flour are shown in Table 2. Moisture content of the noodles decreased with increased supplementation with the control having the highest moisture content of 4.861%.

**Table 2.** Proximate composition of instant fried noodles supplemented with soybean flour and carrot pomace flour.

Sample	Carbohydrate (%)	Moisture (%)	Ash (%)	Crude fat (%)	Crude fiber (%)	Protein (%)	Total carotenoid (mg/100 g)
Control	81.085±0.102 <sup>a</sup>	4.861±0.424 <sup>a</sup>	0.592±0.044 <sup>c</sup>	4.235±0.007 <sup>a</sup>	0.913±0.071 <sup>d</sup>	8.314±0.071 <sup>d</sup>	ND
Sample A	79.214±0.082 <sup>b</sup>	4.497±0.401 <sup>b</sup>	1.521±0.052 <sup>b</sup>	3.161±0.125 <sup>b</sup>	1.446±0.132 <sup>c</sup>	10.161±1.701 <sup>c</sup>	1.336±0.528 <sup>c</sup>
Sample B	74.214±0.132 <sup>c</sup>	4.219±0.401 <sup>c</sup>	2.041±0.032 <sup>b</sup>	3.154±0.121 <sup>ab</sup>	2.103±0.076 <sup>b</sup>	14.311±2.436 <sup>b</sup>	3.592±0.494 <sup>b</sup>
Sample C	71.911±0.201 <sup>d</sup>	3.944±0.792 <sup>d</sup>	2.352±0.210 <sup>a</sup>	2.930 ±0.005 <sup>c</sup>	2.403±0.018 <sup>a</sup>	16.460±0.654 <sup>a</sup>	4.080±0.315 <sup>a</sup>

Control=100% wheat flour, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values shown as mean± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant differences ( $P \leq 0.05$ ). ND-Not detected.

of the noodle strands to evaporate (Gulia et al., 2014; Adejuwon et al., 2020). Moisture content is critical in controlling microbial growth and hence determining the shelf life of the noodles. Carbohydrate content of the noodles decreased with substitution of wheat flour. Sample C with 25% soybean flour and 15% carrot pomace flour had the lowest carbohydrate content of 71.911%. Ash content increased with replacement of wheat flour, noodles containing 60% wheat flour (Sample C) had the highest ash content (2.352%) while the control had the lowest (0.592%). Ash content gives an indication of the availability of minerals in a given food sample. The increase in ash content is attributed to the added soybean and carrot pomace flour.

The percentage protein content of the instant noodles ranged from 8.314 to 16.46%. Sample C had the highest protein content while the control had the lowest. This is attributed to the increase in the proportion of soybean flour added which is rich in protein (Medic et al., 2014). This increase in protein is in agreement with previous studies (Collins and Pangloli, 1997; Adegunwa et al., 2012; Omeire et al., 2014; Rani et al., 2019).

There was a decrease in fat content with substitution of wheat flour, Sample C had the lowest content and was significantly different from other samples. The decrease could be due to

increase in the proportion of soy flour (defatted) in the flour blend. Collins and Pangloli (1997) reported a decrease in fat content of noodles with addition of defatted soybean flour, however, other studies observed an increment in fat content (Adegunwa et al., 2012; Omeire et al., 2014). The increase in the amount of carrot pomace substituted could have also led to decrease in the amount of oil absorbed by the noodles. In a previous study, preharvest-dropped apple powder (PDAP) appeared to be very effective in lowering oil absorption of instant fried noodles (Kim et al., 2013).

The highest fiber content was found in Sample C (2.403%) and the lowest value was in the control sample (0.913%). The increase in fiber content is due to increase in carrot pomace in the blended flour. Similar trends on increase in fiber content were also reported in biscuits with added carrot pomace (Baljeet et al., 2014; Parveen et al., 2017). Dietary fiber plays an important role in prevention of constipation, regulation of blood sugar, protection against heart diseases and prevention of certain forms of cancers (Rajpurohit, 2018).

Carrots is a rich source of carotenoids and beta carotene, they are precursor of vitamin A and act as free-radical scavengers (Sharma et al., 2012; Surbhi et al., 2018). Carotenoids have been linked

with the enhancement of immune system and decreased risk of degenerative diseases such as cancer, cardiovascular disease, age related macular degeneration and cataract formation (Faulks and Southon, 2001; Sharma et al., 2012). There was an increase in the total carotenoids content with increased carrot pomace supplementation as shown in Table 2.

Increase in total carotenoid content with replacement of wheat flour with carrot puree in noodles was also reported by Prerana and Anupama (2020). Since carotenoids are affected by heat (Rodriguez-Amaya and Kimura, 2004), this analysis was done immediately after production of the noodles. There was a significant difference in total carotenoid content of the noodles prepared from the flour blends, with Sample C having the highest amount.

### Mineral concentration

Carrots are good sources of calcium and phosphorous (Surbhi et al., 2018) while soybeans are a good source of magnesium and zinc (Reddy and Duke, 2015). Substitution of wheat flour with carrot pomace and soybean flour led to an increase in the mineral concentration of dry instant noodles (Table 3). Sample C had the highest

**Table 3.** Mineral concentration (mg/100 g) of instant fried noodles supplemented with carrot pomace flour and soybean flours.

Sample	Zinc	Calcium	Magnesium	Phosphorous
Control	1.660±0.329 <sup>c</sup>	33.473±0.513 <sup>d</sup>	34.901± 3.510 <sup>d</sup>	3.31±0.011 <sup>c</sup>
Sample A	2.119±0.168 <sup>b</sup>	51.37±1.512 <sup>c</sup>	49.365± 1.3364 <sup>c</sup>	6.696±0.227 <sup>b</sup>
Sample B	2.451± 0.021 <sup>a</sup>	60.57± 1.70 <sup>b</sup>	53.651± 3.8395 <sup>b</sup>	6.994±2.991 <sup>b</sup>
Sample C	2.602± 0.034 <sup>a</sup>	68.98± 1.661 <sup>a</sup>	55.015± 1.9445 <sup>a</sup>	8.112± 0.1357 <sup>a</sup>

Control= 100% wheat, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values are shown as mean± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant differences ( $p \leq 0.05$ ).

**Table 4.** Cooking time and cooking loss of instant fried noodles supplemented with soybean flour and carrot pomace flour.

Sample	Optimum cooking time(min)	Cooking loss (%)	Water absorption (%)
Control	13.0	9.261±1.258 <sup>d</sup>	125.301±0.134 <sup>d</sup>
Sample A	13.5	9.353±0.124 <sup>c</sup>	128.103±1.534 <sup>c</sup>
Sample B	13.5	11.318±0.371 <sup>b</sup>	130.90± 0.673 <sup>b</sup>
Sample C	14.5	14.034±1.319 <sup>a</sup>	135.50± 0.321 <sup>a</sup>

Control= 100% wheat, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values are shown as mean± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant differences ( $P \leq 0.05$ ).

amount of zinc but was not significantly different from Sample B. Phosphorous content of Sample A and B was not significantly different. Prerana and Anupama (2020) also reported an increase in mineral content of noodles substituted with carrot puree.

### Cooking qualities

Cooking time refers to the time in minutes required to gelatinize the starch core of noodles (Prerana and Anupama, 2020). The cooking time increase with replacement of wheat flour as shown in Table 4. Sample C cooked for 14.5 min, Sample A and B both took 13.5 min while the control cooked for 13 min. The cooking time of noodles in this study was higher than what was reported by Adegunwa et al. (2012); Jalgaonkar et al. (2018) and Rani et al. (2019). Prerana and Anupama (2020) reported a decrease in cooking time with replacement of wheat flour with carrot puree in noodles.

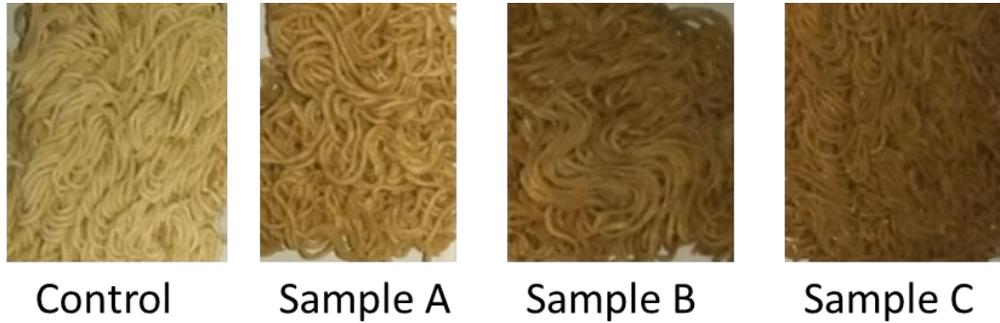
Cooking loss increased with replacement of wheat flour with soy flour and carrot pomace flour. Sample C had the highest cooking loss (Table 4). Cooking loss is an important factor denoting cooking quality of noodles. Structural stability of noodles during cooking process is determined by cooking loss. High cooking loss is undesirable because it represents high solubility of starch, resulting in turbid cooking water, low cooking

tolerance and sticky texture (Wandee et al., 2014). There was significant difference ( $P < 0.05$ ) in the water absorption of all the noodles made. Water absorption increased with substitution of wheat flour. Sample C had the highest percent water absorption (135%) while the control had the lowest value of 125%. The increase in water absorption is attributed to the high protein content of soybean flour (Rani et al., 2019) and high fiber content in the carrot pomace flour.

### Color characteristics of noodles

Color is an important quality trait in noodles. Noodles should be bright in color and slow in discoloration with time after processing (Fu, 2008). Red or dull grey colored noodles are undesirable to most consumers. Factors influencing the color of a product are alkaline formulations used during processing, flour refinement and enzymatic browning associated with polyphenol oxidase (Asenstorfer et al., 2006). Figure 1 shows noodles made from the different composite flour and control.

Color evaluation showed variation in the lightness value among the noodle samples as shown by the L values (Table 5). Lightness of the noodles decreased with replacement of wheat with soybean and carrot pomace flour. The redness ( $a^*$ ) values increased with supplementation with Sample C having the highest value



**Figure 1.** Image of instant noodles made from the different flour composites. Control was made with 100% wheat, Sample A with 80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B with 70% wheat flour, 20% soybean flour, 10% carrot pomace flour and Sample C with 65% wheat flour, 25% soybean flour, 15% carrot pomace flour.

**Table 5.** Color characteristics of instant fried noodles supplemented with soybean flour and carrot pomace flour.

Sample	L*	a*	b*
Control	55.910±1.434 <sup>a</sup>	-1.490±0.141 <sup>d</sup>	19.271±0.121 <sup>d</sup>
Sample A	44.633±1.589 <sup>b</sup>	5.121±0.458 <sup>c</sup>	27.912±1.333 <sup>a</sup>
Sample B	42.312±2.356 <sup>c</sup>	5.631±0.462 <sup>ab</sup>	26.812±0.213 <sup>b</sup>
Sample C	39.673±0.586 <sup>d</sup>	5.712±0.378 <sup>a</sup>	25.231±0.763 <sup>bc</sup>

Control= 100% wheat, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values are shown as mean ± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant differences ( $P \leq 0.05$ ).

**Table 6.** Textural properties of cooked instant fried noodles supplemented with soy flour and carrot pomace flour.

Sample	Tensile strength (N)	Breaking length (mm)
Control	0.280±0.01 <sup>a</sup>	36.512±1.013 <sup>a</sup>
Sample A	0.171±0.021 <sup>b</sup>	28.013±1.213 <sup>b</sup>
Sample B	0.153±0.215 <sup>bc</sup>	27.143±0.154 <sup>c</sup>
Sample C	0.121±1.314 <sup>c</sup>	24.165±0.314 <sup>d</sup>

Control= 100% wheat, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values shown are mean ± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant differences ( $P \leq 0.05$ ).

but was not significantly different from sample B. The yellowness ( $b^*$ ) values also increase with the control being significantly different from the rest of the noodle samples.

### Texture analysis

Textural characteristics of noodles are among the important consideration in determining their quality. The quality of the noodles is primarily defined by texture and

appearance (Ross, 2006). The textile profile of the noodles prepared from the composite flour is shown in Table 6. The tensile strength and breaking length decreased with substitution of the wheat flour. The control had the highest tensile strength and was significantly different from the noodles prepared from the composite flours. This decrease in tensile strength is ascribed to addition of non-gluten flours which weakens the gluten strength of the dough hence the overall structure of the noodles (Kovacs et al., 2004). Gluten make up 80% of the total protein in wheat flour. Gluten is

**Table 7.** Sensory analysis results of cooked instant fried noodles supplemented with soybean flour and carrot pomace flour.

Sample	Taste	Aroma	Color	Texture	Overall acceptability
Control	7.75 ± 0.753 <sup>b</sup>	7.083 ± 1.164 <sup>b</sup>	6.683±1.833 <sup>d</sup>	7.181± 1.601 <sup>b</sup>	6.416 ± 2.094 <sup>d</sup>
Sample A	8.01 ±1.206 <sup>a</sup>	7.510±1.314 <sup>a</sup>	7.751±0.965 <sup>a</sup>	7.272±1.793 <sup>a</sup>	7.916 ± 1.083 <sup>a</sup>
Sample B	6.583±1.564 <sup>c</sup>	7.083± 1.928 <sup>b</sup>	7.33±1.370 <sup>c</sup>	6.181±1.401 <sup>c</sup>	7.010±1.651 <sup>b</sup>
Sample C	5.833±1.589 <sup>d</sup>	6.583± 0.996 <sup>c</sup>	7.583± 1.24 <sup>b</sup>	5.363± 1.689 <sup>d</sup>	6.051±1.564 <sup>c</sup>

Control= 100% wheat, Sample A=80% wheat flour, 15% soybean flour, 5% carrot pomace flour, Sample B = 70% wheat flour, 20% soybean flour, 10% carrot pomace flour, Sample C= 65% wheat flour, 25% soybean flour, 15% carrot pomace flour. Values shown are mean± standard deviation of triplicate analysis. Different superscript letters in a column indicate significant difference (P≤ 0.05).

responsible for dough extensibility and strength, replacing wheat flour impairs the gluten matrix hence leading to the weakening of the noodle texture (Kovacs et al., 2004). Similar trend was reported by other studies who substituted wheat flour with Tilapia bone flour (Sirichokworakit, 2014) and unripe banana flour (Ritthiruangdej et al., 2011).

### Sensory analysis

Sensory parameters of cooked noodles evaluated (taste, aroma, color, texture and overall acceptability) are shown in Table 7. Sample A with 80% wheat flour, 15% soybean flour and 5% carrot pomace was the most preferred by the panelist. Sample C scored the lowest score in taste (5.833), texture (5.363) and overall acceptability (6.051). The control scored the lowest in color. Sensory characteristics like smell, taste, appearance influence food acceptability more than the nutritive value. They play a significant role in the selection of a food item.

### Conclusion

Instant fried noodles were prepared by substituting wheat flour with soybean (15, 20 and 25%) and carrot pomace flour (5, 10 and 15%) in an effort to improve their protein and dietary fiber content. Addition of soybean and carrot pomace flour in the noodles increased their protein, crude ash, crude fiber and total carotenoid content. Cooking time, cooking loss and water absorption of the prepared noodles increased with replacement of wheat flour. Lightness of the noodles decreased with replacement of wheat with soybean and carrot pomace flour. The control (100% wheat flour) had the highest tensile strength and was significantly different from the noodles prepared from the composite flours. Sensory analysis showed that noodles prepared from substitution of wheat with 15% soybean flour and 5% carrot pomace flour had the highest rating in taste, color, aroma, texture and overall acceptability. Soybean and carrot pomace flour can be used to formulate nutritious noodles with acceptable sensory properties.

### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

### REFERENCES

- Adegunwa M, Bakare H, Akinola OF (2012). Enrichment of Noodles with soy flour and carrot powder. *Nigerian Food Journal* 30(1):74-81.
- Adejuwon OH, Jideani AIO, Falade KO (2020). Quality and Public Health Concerns of Instant Noodles as Influenced by Raw Materials and Processing Technology. *Food Reviews International* 36(3):276-317.
- Ahmad M, Wani TA, Wani SM, Masoodi FA, Gani A (2016). Incorporation of carrot pomace powder in wheat flour: effect on flour, dough and cookie characteristics. *Journal of Food Science and Technology* 53:3715-3724.
- AOAC (2010). Official methods of analysis of AOAC International. Volume I, agricultural chemicals, contaminants, drugs / edited by William Horwitz. [Internet document] URL <https://repositorioinstitucional.ceu.es/handle/10637/3158>. Accessed 18/08/2020.
- Arora B, Kamal S, Sharma VP (2018). Nutritional and quality characteristics of instant noodles supplemented with oyster mushroom (*P. ostreatus*). *Journal of Food Processing and Preservation* 42(2):e13521.
- Asenstorfer RE, Wang Y, Mares DJ (2006). Chemical structure of flavonoid compounds in wheat (*Triticum aestivum* L.) flour that contribute to the yellow colour of Asian alkaline noodles. *Journal of Cereal Science* 43(1):108-119.
- Baljeet SY, Ritika BY, Reena K (2014). Effect of incorporation of carrot pomace powder and germinated chickpea flour on the quality characteristics of biscuits. *International Food Research Journal* 21(1):217-222.
- Collins JL, Pangloli P (1997). Chemical, physical and sensory attributes of noodles with added sweetpotato and soy flour. *Journal of Food Science* 62(3):622-625.
- Dewettinck K, Bockstaele F, Van Kühne B, Walle D, Van de Courtens TM, Gellynck X. (2008). Nutritional value of bread: Influence of processing, food interaction and consumer perception. *Journal of Cereal Science* 48(2):243-257.
- Faulks R, Southon S (2001). Carotenoids, Metabolism and Disease. *Handbook of Nutraceuticals and functional foods*. In: *Handbook of Nutraceuticals and functional foods* pp. 143-169.
- Fu B (2008). Asian noodles: History, classification, raw materials, and processing. *Food Research International* 41(9):888-902.
- Gulia N, Dhaka V, Khatkar BS (2014). Instant Noodles: Processing, Quality, and Nutritional Aspects. *Critical Reviews in Food Science and Nutrition* 54(10):1386-1399.
- Gull A, Prasad K, Kumar P (2015). Effect of millet flours and carrot pomace on cooking qualities, color and texture of developed pasta. *LWT - Food Science and Technology* 63(1):470-474.
- Gunathilake KDPP, Abeyrathne YMRK (2008). Incorporation of coconut flour into wheat flour noodles and evaluation of its Rheological,

- Nutritional and sensory characteristics. *Journal of Food Processing and Preservation* 32(1):133-142.
- Huh HJ, Shin WK, Kim Y (2019). Textural and cooking qualities of noodles made with soy flour and hydroxypropyl methylcellulose. *International Food Research Journal* 26(2):421-428.
- Hymavathi TV, Thejasri V, Roberts TPP (2019). Enhancing cooking, sensory and nutritional quality of finger millet noodles through incorporation of hydrocolloids. *International Journal of Chemical Studies* 7(2):877-881.
- Jalgaonkar K, Jha SK, Mahawar MK (2018). Influence of incorporating defatted soy flour, carrot powder, mango peel powder, and moringa leaves powder on quality characteristics of wheat semolina-pearl millet pasta. *Journal of Food Processing and Preservation* 42(4):e13575.
- Kang J, Lee J, Choi M, Jin Y, Chang D, Chang YH, Kim M, Jeong Y, Lee Y (2017). Physicochemical and Textural Properties of Noodles Prepared from Different Potato Varieties. *Preventive Nutrition Food Science* 22(3):246-250.
- Kim Y, Kim Y, Bae IY, Lee HG, Hou GG, Lee S (2013). Utilization of preharvest-dropped apple powder as an oil barrier for instant fried noodles. *LWT - Food Science and Technology* 53(1):88-93.
- Kovacs MIP, Fu BX, Woods SM, Khan K. (2004). Thermal stability of wheat gluten protein: Its effect on dough properties and noodle texture. *Journal of Cereal Science* 39(1):9-19.
- Kumoro AC, Johnny D, Alfilovita D (2016). Incorporation of microalgae and seaweed in instant fried wheat noodles manufacturing: nutrition and culinary properties study. *International Food Research Journal* 23(2):715-722.
- Lu Q, Guo S, Zhang S (2009). Effects of flour free lipids on textural and cooking qualities of Chinese noodles. *Food Research International* 42(2):226-230.
- Majzoobi M, Poor ZV, Jamaljan J, Farahnaky A (2016). Improvement of the quality of gluten-free sponge cake using different levels and particle sizes of carrot pomace powder. *International Journal of Food Science and Technology* 51(6):1369-1377.
- Medic J, Atkinson C, Hurburgh CR (2014). Current knowledge in soybean composition. *Journal of the American Oil Chemists' Society* 91:363-384.
- Omeire G, Umeji O, Obasi NE (2014). Acceptability of noodles produced from blends of wheat, acha and soybean composite flours. *Nigerian Food Journal* 32(1):31-37.
- Pakhare KN, Dagadkhair AC, Udachan IS, Andhale RA (2016). Studies on Preparation and Quality of Nutritious Noodles by Incorporation of Defatted Rice Bran and Soy Flour. *Journal of Food Processing and Technology* 7(10):629.
- Parveen H, Bajpai A, Bhatia S, Singh S (2017). Analysis of Biscuits Enriched With Fibre by Incorporating Carrot and Beetroot Pomace Powder. *The Indian Journal of Nutrition and Dietetics* 54(4):403-413.
- Prerana S, Anupama D (2020). Influence of carrot puree incorporation on quality characteristics of instant noodles. *Journal of Food Process Engineering* 43(3):e13270.
- Rajpurohit D (2018). Breeding Basmati Rice View project Book chapter View project A review: Food, chemical composition and utilization of carrot (*Daucus carota* L.) pomace. *International Journal of Chemical Sciences* 6(3):2921-2926.
- Rani S, Singh R, Kamble DB, Upadhyay A, Kaur BP (2019). Structural and quality evaluation of soy enriched functional noodles. *Food Bioscience* 32:100465.
- Rani S, Singh R, Kamble DB, Upadhyay A, Yadav S, Kaur BP (2020). Multigrain noodles: nutritional fitness and cost effectiveness for Indian Mid-Day Meal. *Food Security* 12:479-488.
- Rathod RP, Annapure US (2017). Physicochemical properties, protein and starch digestibility of lentil based noodle prepared by using extrusion processing. *LWT - Food Science and Technology* 80:121-130.
- Reddy KN, Duke SO (2015). Soybean Mineral Composition and Glyphosate Use. In: *Processing and Impact on Active Components in Food*. Elsevier Inc. pp. 369-376.
- Ritthiruangdej P, Parnbankled S, Donchedee S, Wongsagonsup R. (2011). Physical, chemical, textural and sensory properties of dried wheat noodles supplemented with unripe banana flour. *Kasetsart Journal - Natural Science* 45:500-509.
- Rodriguez-Amaya D, Kimura M (2004). HarvestPlus Handbook for Carotenoid Analysis. HarvestPlus Technical Monographs 59 p.
- Ross AS (2006). Instrumental measurement of physical properties of cooked Asian wheat flour noodles. *Cereal Chemistry* 83(1):42-51.
- Sahni P, Shere DM (2017). Physico-chemical and sensory characteristics of carrot pomace powder incorporated fibre rich cookies. *Asian Journal of Dairy and Food Research* 36(4):327-331.
- Semwal S, Chaudhary N, Karoulia S (2016). Addition of Carrot Pomace to Increase the Nutritional and Rheological Properties of Traditional Cake. *International Journal of Science and Research* 5:1412-1416.
- Sharma KD, Karki S, Thakur NS, Attri S (2012). Chemical composition, functional properties and processing of carrot-A review. *Journal of Food Science and Technology* 29:22-32.
- Siah S, Quail KJ (2018). Factors affecting Asian wheat noodle color and time-dependent discoloration - A review: *Cereal Chemistry* 95(2):189-205.
- Sirichokworrakit S (2014). Physical, textural and sensory properties of noodles supplemented with tilapia bone flour (*Tilapia nilotica*). *International Journal of Biological, Veterinary, Agricultural and Food Engineering* 8(7):689-691.
- Surbhi S, Verma RC, Deepak R, Jain HK, Yadav KK (2018). A review: Food, chemical composition and utilization of carrot (*Daucus carota* L.) pomace. *International Journal of Chemical Studies* 6(3):2921-2926.
- Takahashi T, Miura M, Ohisa N, Mori K, Kobayashi S (2005). Heat treatments of milled rice and properties of the flours. *Cereal Chemistry* 82(7):228-232.
- Udachan IS, Pakhare KN, Dagadkhair AC (2018). Enhancement of nutritional and functional characteristics of noodles by fortification with protein and fiber: A review. *Journal of Pharmacognosy and Phytochemistry* 7(1):351-357.
- Violalita F, Evawati, Syahrul S, Yanti HF, Fahmy K. (2020). Characteristics of Gluten-Free Wet Noodles Substituted with Soy Flour. In: *IOP Conference Series: Earth and Environmental Science*. P. 12047. Institute of Physics Publishing.
- Wandee Y, Uttapap D, Pancha-arnon S, Puttanlek C, Rungsardthong V, Wetprasit N (2014). Enrichment of rice noodles with fibre-rich fractions derived from cassava pulp and pomelo peel. *International Journal of Food Science and Technology* 49(11):2348-2355.
- Xu J, Bock JE, Stone D. (2020). Quality and textural analysis of noodles enriched with apple pomace. *Journal of Food Processing and Preservation* 44(8):e14579.
- Yadav S, Pathera AK, Islam RU, Malik AK, Sharma DP (2018). Effect of wheat bran and dried carrot pomace addition on quality characteristics of chicken sausage. *Asian-Australasian Journal of Animal Sciences* 31(5):729-737.
- Zhu F, Li J (2019). Physicochemical and sensory properties of fresh noodles fortified with ground linseed (*Linum usitatissimum*). *LWT* 101:847-853.