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Characteristics of Noodle Prepared from Orange-fleshed Sweet Potato and Domestic Wheat Flour

Erliana Ginting and Rahmi Yulifianti
Indonesian Legumes and Tuber Crops Research Institute (Iletri)
PO Box 66 Malang 65101, Indonesia

ABSTRACT

Noodle characteristics prepared from both 100% of domestic and imported wheat flour (as a control) and blended with 40% of orange-fleshed sweet potato paste were studied. The domestic wheat flour had higher protein content (13.8%), compared to imported wheat flour (11.7%), thus giving the highest protein content (18.86%) in noodle prepared from 100% domestic wheat flour. However, its noodle colour was disliked due to a lower whiteness level compared to imported wheat flour. Blended 60% of domestic wheat flour with 40% of sweet potato paste could improve the noodle colour acceptance. The noodles prepared from both 100% wheat flour and blended with 40% sweet potato paste had met the national standard quality for moisture and protein content. This suggests that sweet potato paste is promising for noodle ingredients as a wheat flour substitute.

Key words: noodles, orange-fleshed sweet potato, wheat flour.

INTRODUCTION

Noodle is one of Indonesian favourite foods due to its acceptable taste to almost age groups, available at affordable prices and can be produced either by small, medium or large scale industries. The main ingredient of noodle is wheat flour. The dry, wet and instant
noodles constitute the largest portion of wheat flour use (55%), while the rest of 20% is used as ingredient for cake and breads, snacks and biscuits (15%), household (5%) and fried (5%) foods [1]. Increasing use of wheat flour is a result of diet transformation from traditional foods to western foods [2], thus leading to increasing import of this flour.

Indonesia considerably imported large amounts of wheat grains that were about 5.85 million tons in 2010, equivalent to 4.3 million tonnes of wheat flour [3]. In fact, wheat is a sub-tropical crop, thus self-sufficiency of wheat flour would not be possible for Indonesia as a tropical country. However, efforts for wheat cultivation and domestication have been conducted in selected high land areas, such as in Pangalengan (West Java), Dieng, Salatiga (Central Java) and Tosari (East Java) with planting area about 100 ha [4]. In order to meet domestic needs as well as to reduce import of wheat flour, wheat cultivation in larger areas would be further developed.

Selected wheat varieties from India were grown in Indonesia for adaptation trials as well as for breeding purposes. As a result, some domestic wheat varieties have been released which are favourable for tropical conditions [5]. Nias variety which was derived from DWR 162 showed higher yield when cultivated in Tosari, Pasuruan, East Java (3.5 t/ha) than in India (2.5 t/ha) [6]. Therefore, the utilization of domestic wheat flour needs to be promoted and developed along with the development of wheat cultivation in Indonesia. In this study, wheat flour derived from Dewata variety would be used as the ingredient for noodle preparation. Dewata was a domestication variety of DWR 162, which has been released in 2003 with a potential yield of 2.96 t/ha [7].

Diversification of sweet potato utilization into a variety of food products would support the national food security. In particular, the use of orange-fleshed sweet potato gives health benefits with respect to its beta carotene content, which has high pro-vitamin A and anti oxidative activities [8, 9, 10, 11]. In addition, the presence of phenolic compounds that also have function as antioxidants, dietary fiber and relatively low glycemic index (GI) of its carbohydrate, also contribute to functional food properties of sweet potato [10, 12].

Two orange-fleshed sweet potato varieties, namely Beta 1 and Beta 2 had been released in 2009 by Indonesian Ministry of Agriculture with considerably high beta carotene content (12,031 µg and 4,629 µg/100 g fresh weight, respectively) [13]. These figures are higher than beta carotene content in yellow squash (1,500 µg/100 g) and carrots (7,000-12,000 µg/100 g) [14]. However, orange-fleshed sweet potatoes mostly have high moisture [15] that would cause moist and tender texture of the steamed tubers [14, 16], suggesting that this cultivar is
less favoured for direct consumption. Therefore, alternative preparation methods are needed, such as using the mash/paste as an ingredient for different food products, like jam, bakery products, and noodles [16].

In general, noodle is prepared from wheat flour. However, some studies reported that the use of wheat flour could partly substituted with other flours, such as sweet potato flour [17, 18], sweet potato composite flour [19], cassava flour [20], arrowroot and soybean composite flour [21], modified arrowroot starch [22], maize flour [23], and cowpea sprout flour [24]. In comparison to flour, the use of sweet potato paste/mash is more practical and economic due to shorter steps relative to flour processing and gives higher yield recovery compared to sweet potato flour which only ranged from 18 to 30% [12]. Utomo and Yulifianti [25] (2012) reported that noodle containing 40% of purple-fleshed sweet potato paste has acceptable physical, chemical and sensorial performances. Therefore, this study was performed to identify the physical and chemical characteristics as well as sensorial attributes of noodles prepared from blended orange-fleshed sweet potato paste with domestic wheat flours. The promotion and utilization of both commodities as noodle ingredients would ultimately support the diversification program of local food sources.

MATERIALS AND METHODS

The study was performed at the Food Chemistry and Technology Laboratory of Iletri, Malang. Orange-fleshed sweet potato variety, namely Beta 1 (Fig. 1) was harvested from Tumpang, Malang after 4.5-month planting. Domestic wheat grain of Dewata variety (Fig. 2) was obtained from the Laboratory of Agricultural Postharvest Research, Karawang. This grain was polished, then milled into flour (80 mesh). Imported wheat flour (hard wheat type) which was purchased from the local market was used as a control. The fresh tubers of sweet potato were steamed, removed the skin, and then mashed to obtain paste/mash as ingredient for noodle preparation. The experiment was factorial randomized complete design with two factors and three replicates. The first factor was the origin of wheat flour (domestic and imported flours) and the second factor was noodle formulation (100% wheat flour and blended wheat flour with 40% sweet potato paste).

Observations of fresh tubers included the Hunter colours using colour reader Minolta CR-200b and chemical composition, including dry matter and moisture contents (gravimetry) and ash (muffle furnace) according to SNI 01-2891-1992 [26], reducing sugar (Nelson-Somogy method) and crude fiber (fibertec) [27] as described in Sudarmadji et al. [27] and beta-carotene content [28]. Texture profile analysis (TPA) of steamed tubers, included
hardness, adhesiveness, and chewiness were performed using texture analyzer Shimadzu SM-500N-168). Kett whiteness tester was used for detection of whiteness levels of both wheat flours with MgO as a standard (85.6%). Chemical analysis of wheat flours included moisture and ash [26] and protein [29]. Similar chemical analysis was also done for dry noodles produced in addition to their physical characteristics (yield recovery and Hunter colours). While for wet noodles, TPA (hardness, adhesiveness, and chewiness) and sensorial attributes test (colour, aroma, taste, and texture) were performed using Hedonic test with 20 panelists [30]. Wet noodles were prepared through boiling the dry noodles for 10 min.

RESULTS AND DISCUSSIONS

Chemical and physical characteristics of wheat flours and sweet potato tubers

Imported wheat flour had slightly higher moisture content (12.82%) than that of domestic wheat flour (11.28%) (Table 1) that can be due to different packaging and storage conditions. Meanwhile, domestic wheat flour showed much higher ash content (1.38% dw) relative to imported flour (0.65% dw) (Table 1). High ash content, which represents total mineral content of the flour, may give dark colour of the noodle produced [25].

Protein content of domestic wheat flour (13.83% dw) was relatively higher than that of imported flour (11.66% dw) (Table 1), particularly due to genetic factor (cultivar). However, this value was slightly lower than protein content presented in the description of Dewata variety (15.66% dw at m.c. 11%) [7] that might be due to differences in planting season and crop environment conditions. Wheat flour predominantly consists of gluten that is formed from glutenin and gliadin proteins when mixed with water. Gluten plays an important role in dictating noodle elasticity and texture [25]. Wheat flour with protein content of 10-13% is suitable for noodle ingredient [31]. The whiteness level of domestic wheat flour was considerably lower than that of imported wheat flour (Table 1). This may due to dark colour of the seed bran (genetic factor) that could be partly involved in the flour after polishing and milling process.

Beta 1 variety contained high beta carotene content (Table 2) that was showed by deep orange colour of the root flesh. Simonne et al. [32] revealed that beta carotene content of sweet potato positively correlated with orange flesh intensity \((r = 0.99)\). The deep orange colour of the flesh tuber can be also seen through the relatively low lightness \((L^*)\) value (Table 2). Ameny and Wilson [33] and Ginting et al. [16] (2008) noted that \(L^*\) value showed negative correlation with beta carotene content with \(r = -0.74\) and \(r = -0.91\), respectively.
Beta 1 variety also had relatively high moisture (> 73.5%) and reducing sugar contents (> 6.8% dw), but considerably low starch content (< 20% fw) (Table 2) according to Antarlina’s criteria [34]. Orange-fleshed sweet potato tended to have high moisture and low dry matter contents [15], moist and sweet taste when steamed [14, 16].

Table 1. Chemical and physical characteristics of domestic and imported wheat flours

<table>
<thead>
<tr>
<th>Wheat flour</th>
<th>Moisture (%)</th>
<th>Ash (% dw)</th>
<th>Protein (% dw)</th>
<th>Whiteness level (^a) (％)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>11.28</td>
<td>1.38</td>
<td>13.83</td>
<td>60.4</td>
</tr>
<tr>
<td>Imported</td>
<td>12.82</td>
<td>0.65</td>
<td>11.66</td>
<td>71.3</td>
</tr>
</tbody>
</table>

\( \text{dw} = \text{dry weight}; \ \ ^a \text{MgO as a standard (85.6%)} \)

Tabel 2. Chemical and physical characteristics of fresh tubers of Beta 1 variety

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Beta 1 variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (fw)</td>
</tr>
<tr>
<td>Flesh colour (visual)</td>
<td>deep orange</td>
</tr>
<tr>
<td>Fleshcolour:</td>
<td></td>
</tr>
<tr>
<td>L*</td>
<td>68.0</td>
</tr>
<tr>
<td>a*</td>
<td>28.1</td>
</tr>
<tr>
<td>b*</td>
<td>54.6</td>
</tr>
<tr>
<td>Moisture content (%)</td>
<td>79.3</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>1.1</td>
</tr>
<tr>
<td>Crude fiber (%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Reducing sugar (%)</td>
<td>1.8</td>
</tr>
<tr>
<td>Starch (%)</td>
<td>14.2</td>
</tr>
<tr>
<td>Beta carotene (µg/100 g)</td>
<td>12,169</td>
</tr>
</tbody>
</table>

\( \text{fw} = \text{fresh weight}; \ \text{dw} = \text{dry weight} \)
L*: lightness level that ranges from 0 (dark/black) to 100 (bright/white)
a*: green (−100) up to red (+100)
b*: blue (−100) up to yellow (+100)

Table 3. Physico-chemical characteristics of steamed tubers of Beta 1 variety

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content (%)</td>
<td>78.97</td>
</tr>
<tr>
<td>Hardness (N)</td>
<td>7.19</td>
</tr>
<tr>
<td>Adhesiveness (N)</td>
<td>0.02</td>
</tr>
<tr>
<td>Cohesiveness (Ratio)</td>
<td>0.14</td>
</tr>
<tr>
<td>Springiness (mm)</td>
<td>100</td>
</tr>
<tr>
<td>Chewiness (N*mm)</td>
<td>98</td>
</tr>
<tr>
<td>Hunter colour: ( L^* )</td>
<td>53.1</td>
</tr>
<tr>
<td>( a^* )</td>
<td>22.7</td>
</tr>
<tr>
<td>( b^* )</td>
<td>41.4</td>
</tr>
</tbody>
</table>

\( L^*, \ a^*, \ and \ b^* \) description is presented in Table 2.
Table 4. Chemical composition and yield recovery of dry noodles prepared from different wheat flour origins and noodle formulas

<table>
<thead>
<tr>
<th>Wheat flour origin</th>
<th>Formula of noodle ingredient</th>
<th>Moisture (%)</th>
<th>Ash (% dw)</th>
<th>Protein (% dw)</th>
<th>Yield recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic wheat flour</td>
<td>100% wheat flour</td>
<td>8.00 b</td>
<td>1.59 b</td>
<td>18.86 a</td>
<td>104.56 b</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>9.91 a</td>
<td>1.68 a</td>
<td>13.16 c</td>
<td>140.94 a</td>
</tr>
<tr>
<td>Imported wheat flour</td>
<td>100% wheat flour</td>
<td>7.96 b</td>
<td>1.05 d</td>
<td>18.13 b</td>
<td>97.13 c</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>10.08 a</td>
<td>1.39 c</td>
<td>11.15 d</td>
<td>136.58 a</td>
</tr>
</tbody>
</table>

LSD 5%  
CV (%)  
- 1.17 0.07 0.42 6.12  
- 8.12 2.74 1.73 3.19

Values followed by different letters are significantly different at \( p < 0.05 \)

\( dw = \) dry weight

Table 5. Texture Profile Analysis (TPA) of wet noodles prepared from different wheat flour origins and noodle formulas

<table>
<thead>
<tr>
<th>Wheat flour origin</th>
<th>Formula of noodle ingredient</th>
<th>Hardness (N)</th>
<th>Adhesiveness (N)</th>
<th>Cohesiveness (Ratio)</th>
<th>Springiness (mm)</th>
<th>Chewiness (N*mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic wheat flour</td>
<td>100% wheat flour</td>
<td>15.75 b</td>
<td>1.17 b</td>
<td>0.54 a</td>
<td>1.00 a</td>
<td>8.58 a</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>21.84 a</td>
<td>1.96 a</td>
<td>0.51 a</td>
<td>0.87 a</td>
<td>9.64 a</td>
</tr>
<tr>
<td>Imported wheat flour</td>
<td>100% wheat flour</td>
<td>17.31 b</td>
<td>0.48 c</td>
<td>0.52 a</td>
<td>0.86 a</td>
<td>8.38 a</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>19.61 ab</td>
<td>0.69 c</td>
<td>0.53 a</td>
<td>0.86 a</td>
<td>9.15 a</td>
</tr>
</tbody>
</table>

LSD 5%  
CV (%)  
- 4.16 0.28 ns ns ns  
- 11.17 12.90 8.81 11.43 12.37

Values followed by different letters are significantly different at \( p < 0.05 \); ns = not significant

Steaming the fresh tubers caused degradation of beta carotene due to oxidation and/or trans-cis-isomerization of beta carotene [35]. This resulted in changing the bright orange colour to dull/brownish orange colour that was showed by lower \( L^* \), \( a^* \) and \( b^* \) values (Table 3) relative to those of fresh tubers (Table 2). Wu et al. [35] noted that steaming the fresh tubers from 10 to 50 min may lead to 50% reduction in the beta carotene content. Meanwhile, moisture content of the steamed tubers was consistently high and similar to that of fresh tubers (Table 2 and 3), reflecting moist and tender texture of the steamed tubers. The hardness level of steamed tubers was 7.19 N (Table 3), which was in the range of hardness...
values of 12 orange-fleshed cultivars that varied from soft/tender to firm [36]. Similarly, the values of adhesiveness, cohesiveness, springiness and chewiness (Table 3) were within the variation of those 12 cultivars that ranging from 0.0-0.96; 0.11-0.48; 69.95-94.26; 33.0-127.0, respectively [36], suggesting similar texture profile of Beta 1 variety with most orange-fleshed sweet potato cultivars.

**Physico-chemical characteristics of the noodles**

The results showed that the noodle moisture contents were significantly different (Table 4). The noodles prepared from sweet potato paste blended with either domestic or imported wheat flour gave higher moisture content relative to those prepared from 100% wheat flours as sweet potato paste contained higher moisture compared to both wheat flours (Table 1 and 3). In general, the moisture content of noodles prepared from all treatments were below the maximum level (14.5%) of national standard quality for dry noodle [37]. Similarly, differences in ash content were significant with the highest value was showed by the noodle prepared from domestic wheat flour and sweet potato paste (Table 4). This was due to differences in ash content of both wheat flours (Table 1). Ash content may affect the colour of the product. The higher the ash content, the darker the noodle colour [25].

The protein contents of dry noodles also varied (Table 4) with the highest value was seen in noodles prepared from 100% domestic wheat flour (18.86% dw). Meanwhile, the noodle prepared from imported wheat flour and sweet potato paste showed the lowest value (11.15% dw). This was due to higher protein content of domestic wheat flour relative to imported flour (Table 1). National quality standard for protein content of instant noodle is minimal 8% fw or about 8.7% dw for dry noodle prepared from wheat flour [37], suggesting that all noodles prepared in this study had met this requirement.

The yield recoveries of dry noodles were significantly different, giving the highest value on noodles prepared from both wheat flours and sweet potato paste, followed by 100% of domestic wheat flour and 100% of imported wheat flour (Table 4). Sweet potato paste contained higher moisture than wheat flour, resulting in higher noodle yield recovery which was calculated based on the noodle weight.

Wet noodles prepared from both wheat flours blended with sweet potato paste had higher values of hardness relative to those of 100% wheat flours (Table 5), suggesting that this noodle had softer/tender texture. This may due to soft texture of sweet potato mash/paste, which was associated with soft gel consistency of gelatinized sweet potato starch [38]. In addition, Beta 1 variety also contained high moisture (Table 3), that would give moist and
soft texture after steaming. Meanwhile, 100% wheat flour had higher protein/gluten content, resulting in more elastic noodle texture and therefore had lower values of hardness. However, wet noodle prepared from blended of imported wheat flour with sweet potato paste showed similar hardness value to those of other three noodles, reflecting that such ingredients gave no effect on the noodle hardness or texture.

Interestingly, noodles that were derived from domestic flour showed considerably higher adhesiveness values relative to those of imported flour and the highest value was obtained when it was blended with sweet potato paste (Table 5). This may due to differences in moisture content of wet noodles derived from different ingredients. During 10 min boiling, the capacity of noodle to absorb water (hydration) and swell are affected by amylose content, which would dictate the final moisture content of wet noodle. The amylose content of Beta 1 was approximately 16.0% dw [16]. Antarlina and Ginting [39] also reported that sweet potato flour, which had higher amylose content relative to wheat flour, showed higher moisture content of the noodle produced. Utomo [40] revealed that moisture content of steamed tubers positively correlated with its adhesiveness \( r = 0.54** \). Chewiness values of wet noodles as the results of hardness \( x \) cohesiveness \( x \) springiness [41] were similar and seemed to be mainly affected by hardness as the cohesiveness and springiness values were not significantly different (Table 5). This was in agreement with the facts obtained in 21 sweet potato cultivars that hardness positively correlated with chewiness with \( r = 0.99** \) [40]. This reflects that hardness that was dictated by gluten/protein content also affected other texture profiles of the noodle.

**Sensorial attributes of the dry and wet noodles**

The colours of both dry and wet noodles prepared from 100% domestic wheat flour (Fig. 3c) were moderately disliked by panelists (Table 6). However they became slightly liked when blended with 40% orange-fleshed sweet potato paste (Fig. 3d), suggesting that the dark colour of noodle prepared from domestic flour can be improved through sweet potato paste substitution. Conversely, panelists fairly liked the colour of both dry and wet noodles prepared from 100% imported flour (Fig. 3a). This may due to higher whiteness level and lower ash content of imported flour relative to domestic flour (Table 1). Interestingly, they also gave similar scores (like) toward the colour of noodles prepared from imported flour blended with sweet potato paste (Fig. 3b). This reflects that wheat flour substitution with 40% orange-fleshed sweet potato paste likely did not affect the colour acceptance of the noodle.
Aroma of both dry and wet noodles either prepared from 100% imported wheat flour or blended with sweet potato paste was moderately liked by panelists (Table 6). Meanwhile, aroma of both noodles prepared from domestic wheat flour (both formulas) was slightly liked. This was due to detection of specific long-stored flour aroma coming from domestic wheat flour, which had been stored in our storage room for about 4 months prior to be used in this study. In terms of texture, both wet noodles prepared from imported flour (with or without sweet potato paste) showed elastic texture, therefore were moderately liked by panelists (Table 6). Whereas the noodle prepared from domestic wheat flour blended with sweet potato paste was slightly liked as the texture was slightly elastic associated with less gluten content in the ingredient. However, similar texture performance and acceptance was also seen in the noodle prepared from 100% domestic flour, which had higher protein content (Table 1 and 4). This suggests that protein/gluten content of wheat flour is not the only factor which governs the noodle texture, but also starch characteristics, like amylose-amylopectin ratio, starch pasting properties, and swelling power [41]. However, these characteristics were not analyzed in this study.

Table 6. Sensorial attributes of dry and wet noodles prepared from different wheat flour origins and noodle formulas

<table>
<thead>
<tr>
<th>Wheat flour origin</th>
<th>Formula of noodle ingredient</th>
<th>Dry noodle</th>
<th>Wet noodle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Colour a</td>
<td>Aroma a</td>
</tr>
<tr>
<td>Domestic wheat flour</td>
<td>100% wheat flour</td>
<td>2.1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>3.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Imported wheat flour</td>
<td>100% wheat flour</td>
<td>4.2</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>40% sweet potato paste</td>
<td>4.0</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Score: a Acceptance toward colour, aroma, texture and taste:
1 = Dislike very much
2 = Dislike moderately
3 = Like slightly
4 = Like moderately
5 = Like very much
b Texture:
1 = Very firm
2 = Firm
3 = Elastic slightly
4 = Elastic
5 = Very elastic

The score of noodle taste prepared from 100% domestic flour was slightly disliked (2.5), but it could be improved through blending with sweet potato paste (3.2), even though the criteria was still the same (Table 6). Similar finding was also seen in noodle prepared from 100% of imported flour (slightly like) which became like after blending with sweet
potato paste, reflecting that using of 40% sweet potato paste as ingredient could improve the noodle taste.

Fig. 1. Orange-fleshed sweet potato of Beta 1 variety

Fig. 2. The polished-wheat grains of Dewata variety (domestic wheat)

Fig. 3a. Noodle prepared from 100% imported wheat flour

Fig. 3b. Noodle prepared from blended imported wheat flour with 40% of orange fleshy sweet potato paste

Fig. 3c. Noodle prepared from 100% domestic wheat flour

Fig. 3d. Noodle prepared from blended domestic wheat flour with 40% of orange-fleshed sweet potato paste

Overall, the highest scores of noodle colour, aroma, texture and taste acceptance were obtained from the formula of 100% imported wheat flour (23.2), followed by imported flour blended with sweet potato paste (22.5), domestic flour blended with sweet potato paste (17.6) and 100% domestic flour (15.1). This suggests, that the use of 40% sweet potato paste as
wheat flour substitution in noodle preparation is promising and needs to be further developed in commercial scales. This proportion of sweet potato paste was considerably higher relative to sweet potato flour that only could replace 10–20% of wheat flour use in noodle preparation (17, 18, 42).

**Estimated beta carotene content in wet noodle**

The dry noodle containing 40% of sweet potato paste and 60% of wheat flour was analyzed and contained beta carotene about 6,169 µg/100 g fw (at 10% moisture content) or 6,854 µg/100 g dw. Assuming 20% of beta carotene loss during boiling [43], wet noodle contained beta carotene about 2,193 µg/100 g fw (m.c 60%). The Recommended Daily Allowances (RDA) for beta carotene varied for adult (4,800-6,000 µg) and children (2,400-4,200 µg) [44]. This suggests that consumption of 100 g of wet noodle would meet approximately 46% and 91% of the minimum RDA for adult and children, respectively.

**CONCLUSIONS**

Orange-fleshed sweet potato paste was promising to substitute 40% of both domestic and imported wheat flours with respect to its physical, chemical and sensorial characteristics. Blending the domestic wheat flour with sweet potato paste could improve the colour of the noodle produced relative to that of 100% domestic wheat flour.

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