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Proximate, Mineral Composition and Sensory Acceptability of Home Made Noodles from Stinging Nettle (*Urtica simensis*) Leaves and Wheat Flour Blends

Dagem Alemayehu[1,*], Gulelat Desse[2], Kebede Abegaz[1], Beruk Berhanu Desalegn[1], Dereje Getahun[1]

[1]School of Nutrition, Food Science and Technology, Hawassa University, Southern Ethiopia
[2]Botswana College of Agriculture, Gaborone, Botswana

Abstract The objective of this study was to assess the effect of blending proportion of dried nettle (Urtica simensis) leaves flour on the proximate composition, mineral contents (Fe, Ca and Zn) and sensory qualities of wheat based noodles. Standard methods were used to analyze the proximate composition and mineral contents of sample noodles. Five point hedonic scales were used for sensory acceptability test of the noodles using 15 panelists with duplicate. Protein, ash, fiber, Ca, Fe and Zn contents of nettle supplemented noodles were significantly ($p < 0.05$) higher than that of wheat noodles (control). The sensory acceptability test revealed that, nettle supplemented (5-15%) noodles were accepted above the average in all sensory attributes, but the highest acceptability was exhibited in wheat noodles (control). Nutritious and acceptable noodle can be prepared by supplementing wheat with dried nettle (Urtica simensis) leaves flour up to 15%w/w.

Keywords Nettle, Noodle, Supplementation, Acceptable, Nutritious

1. Introduction

The words “pasta” and “noodles” are occasionally used as interchangeably due to the products are basically the same type and mainly produced from wheat semolina or fine flour and water, intermittently produced from other cereals like rice, corn; eggs and spices [30, 28-31]. Pasta and noodles are end products made during processing of wheat which are staple foods in several countries. These products differ in their place of origins, raw materials used for producing, composition of ingredients, industrial procedures and also eating patterns [32-36]. Food products like pasta and noodle products have existed for more than a millennia years and playing significant function for both nutritional and societal values of human beings [37, 38]. The consumption of these products has been increasing at global level due to the ease of transportation, cooking, mechanizations, and development of infrastructure [39, 31, 47]. Pasta mainly made from coarse semolina milled from durum wheat, T. durum which is mixed with water and then extruded through a metal die under pressure [35, 34]. Pasta can be made into dried and filled products including spaghetti and macaroni, ravioli and tortellini [35]. All of these are usually eaten with sauces [34] and the characteristics of cooked pasta should be clean and yellow in color, firm and free from surface stickiness [35].

There is strong evidence that Asian noodles originated from the north of China as early as 5000 BC [48]. Today, a wide variety of Asian style noodles are available, varying in their ingredients, processes applied and the form of the finished products [41]. This diversity reflects differences in culture, climate, region, and a number of other factors [33]. (Hou 2001). Asian noodles are cooked and consumed in many different ways. They can be boiled and served in soup, boiled and served hot or cold as a side dish, stir fried with vegetables and meat, or used as a thin sheet to wrap other ingredients such as Japanese gyoza, Chinese wonton and other dim sum snacks [35].

Noodles are made from a milled material that consists of very much finer particles than those used in pasta production. The flour used can be from either hard or soft grained varieties of bread wheat, T. aestivum, along with water and salt (common salt). Another commonly used ingredient is alkaline salts, also known as kansui [34] and this often consists of a mixture of sodium and potassium carbonates [50]. The primary processes of manufacture are of sheeting and cutting of dough which usually incorporates relatively low water addition compared to those used for bakery products [35, 32, 48].

Plant-based or animal-based ingredients are usually incorporated into pasta and noodles to serve as nutrition enhancers or to provide specific physiological functions. According to World Health Organization and U.S. Food and

* Corresponding author:
dagemmame@yahoo.com (Dagem Alemayehu)
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Drug Administration (FDA), these products can be used as carriers of nutrients [49]. Pasta and noodle products are known with having low in fat and sodium, and rich in complex carbohydrates. Due to boosting and modernization of food industry, the global food market is becoming more diversified. For this purpose, development and studying of new pasta and noodle products with good nutritional, functional and acceptability is inevitable work. In the last few decades, consumers have increasingly demanded wheat-based products considering them to have added value [51]. Thus, many studies have been conducted to improve the nutritional qualities of traditionally prepared food like pasta and noodles using both animal and plant products [51]. Nettle is one of wild plants and growing in temperate areas. It is a name given for more than 30 species of flowering plants which are categorized under the genus *Urtica* of the family *Urticaceae* [1]. *Samma* (*Urtica simensis*) is among the species of Nettle endemic in Ethiopia. In Ethiopia, it is grown in highlands of Amhara region around North & South Gondar, North & South Welo, North Shewa, and Wag Hamra, Gojam; Oromia region around Kofole of Arsi zone and in most highlands of Sidama Zone in southern region and used as famine food [52]. Samma (*Urtica simensis*) has been used as food and medicinal plant traditionally. The potential of Samma (*Urtica simensis*) for food and nutrition security and health is still undermined. According to [25], Samma (*Urtica simensis*) has high nutritional value compared to many green leafy vegetables commonly cultivated and consumed in Ethiopia. Its protein and mineral content is exceptionally high which makes this vegetable as an inexpensive but high quality nutrition source. Beside this, Samma (*Urtica simensis*) extracts can be used for therapeutic function [53]. So far, the study of Samma (*Urtica simensis*) and formulation of different food products in Ethiopia is rare [25] (Assefa et al., 2013). Therefore, the objectives of this study were to develop noodle from wheat flour and Samma (*Urtica simensis*) leaves flour and assess the effect of blending proportion on the proximate composition, mineral (Fe, Ca & Zn) contents and sensory acceptability of noodles.

2. Materials and Methods

2.1. Sample Collection and Preparation

Sample collection

Commercial pasta wheat flour with 12% moisture and 10.2% protein contents was purchased from ASTCO Food Complex Factory, Addis Ababa, Ethiopia. Nettle (*Urtica simensis*) leaves were collected from Fiche area, North Shewa, Ethiopia where this plant is highly consumed.

Sample Preparation

Young shoot of *nettle* (*Uritca simensis*) leaves were separated from its steam using sanitized protective gloves. Then, the nettle leaves were washed using de-ionized water and air dried at room temperature (20-22°C) until constant weight was attained. The dried leaves were milled and sieved at 500µm (Axel Kistner, London, England) to produce nettle flour. Following this, the sieved nettle flour was filled in to air tight polyethylene bags and hermetic sealed and kept in desiccators until needed for analysis and noodle production.

2.2. Noodle Preparation

A small-scale standardized laboratory procedure was used for noodle manufacturing. Based on the blending proportions (100:0, 95:5, 90:10, 85:15 and 80:20) of commercial pasta wheat flour and nettle flour respectively was mixed using small scale bench top electric dough mixer machine at lowest speed until a homogenous mix was achieved. Then, on the homogenized flour distilled water was added, mixed until the ‘‘dough’’ had an adequate consistency for lamination. The doughs which were prepared from different mix of flours then divided by hand in 150g and laminated using a pasta home scale size lamination machine or rolling pin using a 3-step procedure: hand lamination, up to approximately 10-mm thickness; roll lamination, up to a 5-mm thickness; and final roll lamination to a 2-mm thickness of noodle.

2.3. Cooking Noodle

Noodles samples were cooked in small stainless steel thick bottomed sauce pan (5-7 min, salted boiling water at 95°C) occasionally it was stirred with wooden kitchen spoon to prevent sticking each other. Then strained, rinsed and washed with cooled running water (20°C), before testing noodles, it was strained from cooking water and placed in plastic bag for evaluation.

2.4. Chemical Analysis

All the chemicals used in this research were analytical grade. The proximate composition (moisture, total ash, crude protein, crude fat and crude fiber) of the samples were analyzed using [46]. The utilizable carbohydrates and total energy of the samples were calculated by subtracting total ash, crude protein, crude fiber and crude fat from 100. The energies of samples were also calculated by using the Atwater’s conversion factor, 4kcal/g for protein and carbohydrate and 9kcal/g for fat. The mineral contents (Fe, Zn and Ca) were analyzed by the procedure of [46] using an Atomic Absorption Spectrophotometer.

2.5. Sensory Evaluation

Sensory acceptability was conducted at laboratory level using five point hedonic scales with 15 panelists. The five noodle samples prepared from different proportions of wheat and nettle with duplicate were coded with three digit numbers and assessed for its color, taste, aroma, texture and overall acceptability. The five point hedonic scales which was used in this study was 5 = Excellent, 4 = Very good, 3 = Good, 2 = Satisfactory and 1 = Unsatisfactory.

2.6. Experimental Design and Statistical Analysis

The data collected from proximate composition analysis and mineral analysis (Fe, Zn and Ca) of noodle were arranged in completely randomized design (CRD) whereas the sensory evaluation data was arranged in randomized completely block design (RCBD) in order to block the error which could come between panelists and within a panel. Analysis of variance (ANOVA) was done using SPSS 16.0 version software. The mean separation values were determined using a Fischer LSD test. Significant differences were defined at $p<0.05$. The results were presented as Mean ± SE.

3. Results and Discussion

3.1. Proximate Analysis of Dried Nettle (*Urtica simensis*) Leaves

According to table 1, the moisture content of dried nettle leaves was 8.8%. This result is lower than moisture contents of Urtica simensis (82.7-88.3% and 76.8-79%), Urtica dioica (75.1-91.7% and 65-90%), Okra fruit seed (9.69-13.33%), Maize (11.04%), Bitter leaf (10.02%), Indian Spinach (11.57%), Scent leaf (12%), Amaranthus hybridus leaves (10%), Fluted pumpkin (98.5%), Bitter leaf (87.5%), Water leaf (91.6%), Kale (81.38%), pepper (8.8-9.2%) and Drum stick (87%) [27, 26, 25, 24, 23, 22, 21, 20, 19, 18]. basis and differences in drying level, maturity stages of leaves, growing areas and crop items. Comparable result was observed with flour prepared from Anchote (Coccinya abysinica) (5.57-10.41%) [17]. The ash content of dried nettle leaves in the present study (19.7%) is higher than ash contents of stinging nettle leaves (Urtica dioica) (1-3.4% and 3.4-18.9%), Okra fruit (5.37-11.30%), Anchote (Coccinya abysinica) (5.18-9.70%), some Nigerian vegetables (5.02-15.55%) [24, 21, 17]. This might be due to differences in species between Urtica's and differences in the nature of different crops. Likewise the protein contents of dried nettle leaves used in the present study had 21.4%. This is comparable with protein contents of chickpea (20.23-21.07%) and haricot bean (17.95-21.95%). But it is higher than protein contents of carrot (3.57-5.68%), Orange fleshed sweet potato (4.6%), Maize (9.01%), and Anchote (3.91-6.44%) [16, 17, 15, 14, 20].

Similarly, the fat, fiber, utilizable carbohydrate and energy contents were 4.4%, 9.7%, 36% and 269.2 kilocalorie respectively. Comparable result was observed in Scent leaf (4.02%), Maize (4.61%) and Anchote (3.44-5.10%) for fat; dried nettle leaves (8.5-9.4% and 3.5-9.7%) for fiber; pepper (35.3-39.5%) and dried nettle (31.8-37.7%) for carbohydrate and dried nettle leaves (252.2-271.9 kcal) for energy [23, 20, 17, 25, 26, 18].

The mineral contents of plant products are significantly affected by the soils on which the plants were grown, pH and organic matter [13]. According to table 2, the iron, calcium and zinc contents of dried nettle in the present study were 34.3, 813 and 1.3mg per 100g on dry weight basis. The result in this study is higher than Fe contents of dried nettles (3.4-30.3mg and 1.2-3.4mg), Anchote (0-12.9mg), Kale (8.94mg), Pepper (6.9-9.6mg), Chickpea (3%), Cowpea (2.6mg), Lentil (3.1mg) and Green pea (2.3mg) per 100g [16, 26, 24, 19, 18, 12]. Likewise, the calcium contents in the present study is higher than dried nettle (278-788 and 76.86-793.4mg per 100g), Kale (4.05mg per 100g), Pepper (54.6mg per 100g) and Anchote (125.46-524.20mg per 100g) [25, 24, 18, 17]. Similarly, the Fe contents in the present study is slightly higher than Fe contents in Nigerian leafy vegetables (Bitter leaf, Bus-buck, Scent leaf and Hibiscuss sabdariffa) which was in the range of (16.43 and 23.36mg per 100g) and Ca contents of Bitter leaf, Indian spinach, Bus-buck, Scent leaf, Amaranthus hybridus, Telfaria occidentalis and Hibiscuss sabdariffa) which was between 61.19 and 110.16mg per 100g [23]. The Zn contents in the present study were lower than Zn contents of Chickpea (2.22-2.55mg and 6.8mg per 100g), Cowpea (5.1 mg), Lentil (4.4mg), Green pea (3.2mg) and Haricot bean (1.5-2.82mg) per 100g [11, 12, 15].

Many studies have been conducted to improve the nutritional qualities of traditional staple foods. Traditional noodle and pasta products are made from wheat semolina or common flour and water, with or without salt [31]. These products are rich in carbohydrates but lack other essential nutrients, such as dietary fiber, vitamins, and minerals, which are already lost during flour refinement [10]. Potentially, animal sources like egg (wheat), dairy products, calf liver and sea foods and plant sources like legumes, cereals, vegetable and vegetable oils can alleviate this problem [31]. According to table 3, the proximate compositions for noodle prepared from different proportions of wheat and nettle leaves flours shown significant difference ($p<0.05$) from the wheat noodle (control). Moisture contents of a given product are critical for microbial growth and determination of shelf life [16]. The moisture contents of noodles produced in the present study showed increment as the amount of nettle added on wheat increased. This could be due to the fact that moisture contents of nettle leaves flour (8.8%) were higher than those of wheat's. Similar trend was observed in pasta produced from wheat and chickpea and defatted soya [42]. The protein content of noodles was in the range of 9.89 and 13.40%. Comparable results were seen in pasta produced from wheat and chickpea and deffated soya (9.17-11.33%), pasta produced from wheat alone at different time and area (11.3%, 11.8%, 11.7%, 11.97%), and macaroni produced from wheat, barley and soybean (9.61-11.51%) [2, 42, 8, 7]. Similarly, as the amount of nettle flour incorporated increased in the noodle, the protein content was significantly ($p<0.05$) increased. Similar fashions were seen in pasta produced from chickpea and deffated soya; macaroni produced from wheat, barley and soybean [2, 42]. According to 3, the fat contents of the noodles were between 0.29-0.68%. Comparable results were recorded in semolina wheat (0.8%, 0.93%), pasta from wheat and germinated horse gram (0.07-0.63%)

and pasta from wheat with chickpea and Quinoa (0.25-0.96%) [42, 43, 7, 44]. In the present study, the noodle produced from wheat alone (control) had the highest fat whereas the lowest was scored in noodle produced from the highest nettle incorporated on wheat. This could be due to lower contents of fat in nettle leaves flour (4.4%) than wheat (7.2%) [45]. On the contrary, addition of soybean on wheat increased the fat contents of cookie product, addition of amaranth flour on buck wheat flour and increment of cowpea on cocoyam flour for pasta production increased the fat contents [45, 42, 5]. This could be amaranthus, cowpea and soybean have higher fat contents than their counter components. Ash and dietary fiber of noodles were increasing significantly ($p<0.05$) while the amount of nettle leaves flour was increasing (Table 3). This might be due to higher amount of ash (19.7%) and fiber (9.7%) in nettle leaves flour (table 2) than wheat flour ash (0.45%, 0.54%, 1.2%, 2.4%) and fiber (0.2%, 1.62%, 1.81%, 2.76%) [42, 7, 4, 8]. Similar increment trend were observed in study conducted on pasta produced from Buck wheat, amaranthus and rice; wheat and germinated horse gram, cocoyam and cowpea; wheat, barley and soybean, cookie produced from wheat and soybean on ash and dietary fiber [45, 44, 5, 42, 2]. The ash and dietary fiber contents of noodles in this study were in the range of 0.73-2.66% and 0.08-2.65% respectively (table 3). Comparable results were recorded in pasta from semolina wheat chickpea and Quinoa [43]. The utilizable carbohydrate and gross energy were in the range of 73.79-80.42 and 351.44-367.38 respectively and both were decreasing while the amount of nettle flour on noodle increasing (table 3). The decrement in energy contents in noodles produced higher amount of nettle leaves flour was due to the presence of lower amount of fat in the nettle leaves flour which can give more energy beside having lower amount of carbohydrate than wheat (table 1) [45]. Similar carbohydrate fashion was exhibited on pasta produced from cocoyam: cowpea blends [5].

The mineral contents of noodles produced in this study were significantly affected ($p<0.05$) by blending proportion (Table 4). As the amount of nettle leaves flour increased in the proportion with wheat flour, the amount of calcium, iron and zinc were significantly increased ($p<0.05$). Similar results were observed in cookie produced from wheat: moringa blends, quality protein maize based complementary food and wheat: soybean cookie [16, 45, 3].

Table 1. Proximate composition of dried *samma* leaves flour (dry weight basis)

Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Utilizable Carbohydrate (%)	Energy (kcal)
8.8	19.7	21.4	4.4	9.7	36	269.2

Table 2. Mineral content of dried *Urtica semensis* leaves (mg/100g)

Iron	Zinc	Calcium
34.3	1.3	813

Table 3. Effect of blend proportion on proximate composition of wheat noodles supplemented with nettle leave flour. (Mean ± SE)

Levels	Moisture	Protein	Fat	Ash	Dietary Fiber	Carbohydrate	Gross energy
Control	7.19±0.06^{a}	9.89±0.35^{a}	0.68±0.01^{d}	0.73±0.01^{a}	0.08±0.00^{a}	80.42±0.34^{e}	367.38±0.12^{e}
5%	7.66±0.02^{b}	11.78±.035^{b}	0.65±0.01^{cd}	1.25±0.03^{b}	0.45±0.01^{b}	77.80±0.31^{d}	363.94±0.32^{d}
10%	7.85±0.12^{bc}	12.65±0.33^{b}	0.59±0.01^{c}	1.71±00^{c}	1.13±0.00^{c}	76.07±0.11^{c}	358.75±0.26 ^{c}
15%	8.07±0.07^{cd}	13.14±0.12^{c}	0.39±0.00^{b}	2.00±00^{d}	2.16±0.02^{d}	74.63±0.01^{b}	354.63±0.43^{b}
20%	8.18±0.08^{d}	13.40±0.15^{c}	0.29±0.02^{a}	2.66±08^{e}	2.65±0.01^{e}	73.79±0.01^{a}	351.4350±0.23^{a}

$^{a-e}$ Any two means in the same column not followed by the same letter are significantly different ($p<0.05$)

Table 4. Effect of blend proportion on minerals contents of wheat noodles supplemented with nettle leaves flour. (M± SE)

Blend Proportions	Minerals (mg/100g)		
	Calcium	Iron	Zinc
Control(100% wheat flour)	51.31±0.21^{a}	3.07±0.01^{a}	0.60±0.02^{a}
5%	249.71±1.26^{b}	5.35±0.02^{b}	0.96±0.02^{b}
10%	353.15±0.17^{c}	5.770±.01^{c}	1.02±0.00^{c}
15%	370.78±0.23^{d}	5.93±07^{d}	1.12±0.00^{d}
20%	694.82±0.45^{e}	6.14±0.01^{e}	1.25±0.00^{e}

$^{a-d}$ any two mean values within the same column not followed by the same letter are significantly different

Table 5. Effect of blending proportion on sensory attributes of nettle-noodle (Mean ± SE)

Blend proportions	Sensory Attributes				
	Color	Aroma	Texture	Taste	Overall acceptability
100% Wheat	4.20±0.25[c]	4.40±0.16[c]	4.30±0.15[c]	4.55±0.15[b]	4.35±0.15[c]
5% nettle	4.00±0.21[c]	4.60±0.16[c]	4.20±0.13[c]	4.55±0.14[b]	4.50±0.14[c]
10% nettle	4.10±0.12[c]	4.50±0.17[c]	3.65±0.23[b]	4.20±0.14[b]	4.40±0.14[c]
15% nettle	3.20±0.20[b]	3.45±0.15[b]	3.45±0.24[b]	3.90±0.23[b]	3.60±0.16[b]
20% nettle	2.35±0.15[a]	2.35±0.15[a]	2.70±0.15[a]	2.00±0.33[a]	2.70±0.21[a]

[a-c] Any two means within the same column and not followed by the same letter are significantly different.

Assessing human responses using sensory acceptability test in new product development is inevitable activity besides looking the nutritional, safety and convenience of a give product. In the present study acceptability of the noodles produced from different proportions of wheat and nettle leaves flour was assessed using sensory attributes like color, aroma, texture, taste and overall acceptability (table 5). The noodle color was affected significantly ($p<0.05$) as the amount of nettle increased in the present study. This could be due to greenish color of nettle leaves affected the conventionally accepted and preferred bright yellow translucent pasta products [2]. Likewise, the aroma and taste, generally understood as flavor, significantly ($p<0.05$) affected due to increment of nettle leaves flour in the noodles prepared in this study (table 5). This might be due to increment of protein in the nettle incorporated noodles which resulted in development of undesirable flavors in the noodles [16]. The texture of noodles was significantly decreased ($p<0.05$) while the amount of nettle leaves flour incorporated increased (table 5). This could be due to higher contents of fiber in the nettle leaves flour incorporated (9.7%) and decrement in gluten contents on the noodles prepared from nettle incorporated flour. Even though all the noodles prepared in the present study scored above the average (2.5) out of 5, the overall acceptability was affected while the amount of nettles incorporated increased in the noodles (table 5). This might be due to cumulative effect of color change from the conventional noodle, gluten decrement, fiber increment and the flavor change due to protein increment.

4. Conclusions

As conclusion, nettle (Urtica simensis) leaves is a potential source of both for macro and micro-nutrients for human food. Addition of nettle (Urtica simensis) leaves on wheat flour significantly ($p<0.05$) increased the amount of crude protein, ash, dietary fiber, Ca, Fe and Zn. On the contrary, it decreased the amount of fat, carbohydrate and gross energy. Moreover, addition of nettle (Urtica simensis) leaves on wheat flour significantly ($p<0.05$) reduced the sensory acceptability of noodles. Generally, nutritious and acceptable noodle can be prepared by supplementing wheat with dried nettle (Urtica simensis) leaves flour up to 15%w/w.

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