

Development of Instant Ox Tail Soup Supplemented with Mushroom and Moringa Leaves

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Authors' contributions

This work was carried out in collaboration between both authors. Author MLM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LGN managed the analyses of the study. Both authors managed the literature searches, read and approved the final manuscript.

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ABSTRACT

Background: Food consumption has been changing during the past decade and need for instant formulation is being increased. The potential of growth of convenience foods in Kenya is vastly untapped.

Objective: This study was to develop a dehydrated instant ox tail soup mix supplemented with mushroom and *Moringa* leaves and other vegetables to enhance its protein quality and reduce the difficulty in preparation of the soup in order to minimize the problem of protein-energy malnutrition in Kenya.

Methods: After destalking, washing was done. The whole leaves were boiled with 0.1% (v/v) sodium metabi-sulphite for 10 minutes. The leaves were then spread out on the racks for 15 min. The leaves were then spread thinly on mesh and allowed to dry in the oven dryer for four 4 hours. The dried leaves were ground into powder and packaged in a plastic container and stored at room temperature. Fresh oyster mushrooms (*Pleurotus ostearus* (Jacq.) P. Kumm. were cleaned, chopped into small pieces of about 5-7 mm thickness, then pretreated by blanching in water at 60°C for about 2 minutes, cooked and dried to a moisture content of 5-7%, then dried, sieved and stored in airtight containers. The oxtail was cut into small pieces and soaked in vinegar for 10 minutes this is because vinegar tends to kill salmonella, E coli and other gram-negative bacteria. It

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was then taken to an oven to dry it further at 70°C for 48 hours, then ground and packed in airtight container at room temperatures. Tomatoes were cut into slices, cooked, cooled, and the pulp was dried in an oven drier for 3 hours at 60°C. The dried pulp was ground and packaged in airtight glass containers. Proximate analysis was done according to AOAC methods (2005).

Results: Proximate analysis were as follows: Oyster mushroom powder the fat, ash, protein, moisture and total carbohydrates were as follows 2.5%, 8.1%, 31.5%, 3.73% and 40.8% respectively on dry weight basis. In the case of *Moringa* powder the fat, ash, protein, and total carbohydrate results were as follows: 6.3%, 9.5%, 33.4%, and 57.63%.

Ox tail powder the results were as follows fat was 14.6%, ash 5.1%, protein 23.7%, total carbohydrates 36.2% and moisture content 4.72%.

Conclusion: Instant oxtail soup supplemented with mushroom and *Moringa* Leaves can be developed using Oyster mushroom.

Keywords: Instant; ox tail; soup; supplement; mushroom; Moringa leaves.

1. INTRODUCTION

Food consumption has been changing during the past decade and need for instant formulation is being increased. The potential of growth of convenience foods in Kenya is vastly untapped. Convenience foods are foods which require the least handling procedures such as mild heating/warming for ready to eat products or rehydration in hot/cold water for dehydrated foods [1]. However, the major importance is to provide convenience by way of saving the cooking time and labor in the kitchen. In addition, convenience for long shelf-life, reduction in weight, good quality, easy commercial availability are of great concern.

The diet of many rural and urban dwellers is significantly deficient in protein and high in carbohydrate. The implication of this kind of lifestyle an increased incidence of malnutrition and dietary diseases; a situation in which children and especially pregnant and lactating women are most vulnerable. *Moringa* leaves could possibly be a remedy to this and an extremely valuable food source because of its high nutrient profile [2], if used in fortifying sauces, juices, spices, milk, bread and most importantly instant soups.

Moringa (Moringa oleifera) leaves are particularly rich in tocopherols, β -carotene, protein, vitamins and minerals [3]. The vitamin C content of *Moringa* leaves is seven times higher than that of oranges, its vitamin A content is four times to carrots, calcium is four times, and protein content is two times to that of milk while potassium three times that of banana. The leaf is also rich in several antioxidant plant compounds [4].

Tomatoes are one of the major food sources of carotenoids, providing an estimated 80% of daily

intake of lycopene, and of folate, ascorbic acid, flavonoids, α -tocopherol and potassium [5,6].

Moringa leaves A



Onion (Allium cepa L.) in its raw form is recognized as an anti-platelet that may contribute to the prevention of cardiovascular disease [7]. It is thought to be a vegetable, it is high in food value, moderate in protein content and rich in calcium and riboflavin [8].

Ox tail is also underutilized in the country and through this research its value addition into soup powder could potentially improve its utilization. It also contains trace elements of calcium, high source of proteins and carbohydrates. It also has a high fat content, but this fat are not trans fats therefore considered safe for human consumption.

Oyster mushroom contains protein, fat, carbohydrate, minerals, vitamins, amino acids and active ingredients makes it an ideal choice for food supplementation [9]. Mushrooms have several medicinal properties, in addition to their nutritional properties [10]. It contains a variety of nutrients therefore can be used to substitute fish,

meat fruits and vegetables [11]. It is an excellent source of protein. Mushrooms possess serious potential in the global cuisine not only due to their nutritional values but also due to their structural properties that exhibit immense antioxidant properties [12].

Raw oxtail



2. MATERIALS AND METHODS

2.1 Sample Preparation

2.1.1 Sample collection

Moringa leaves were obtained from a farmer in Kiserian town. Tomatoes were obtained from Ngong market. Oyster mushrooms were obtained from a local grocery known as Zucchini grocery. Two kilograms of Ox tail was obtained from the local butchery in Ngong town.

2.1.2 Preparation of *Moringa* leaf powder

Moringa leaves processing was carried out by making modification in the method described by Farzana et al. [9]. After destalking, the leaves were washed. The whole leaves were then boiled with 0.1% (v/v) sodium metabisulphite for 15 min. It was spread out on the racks for 10-15 min. to drain out excess water. The leaves were then spread thinly on mesh and allowed to dry in the oven drier for approximately 4 hours. The dried leaves were grinded into powder and then packaged in a plastic container with cover and stored at room temperature.

2.1.3 Preparation of mushroom powder

Fresh oyster mushrooms were cleaned and chopped into small pieces of about 5-7mm thickness. 2 kg of fresh mushroom pieces were pretreated by blanching in water at 60°C for about 2 minutes. The pretreated slices were then cooked and later dehydrated in an oven drier at 70°C. the velocity of the drying air was kept constant. They were dried to a moisture content

of 5-7% approximately. The dried mushrooms slices are cooled powdered and sieved at BS 30 and stored in airtight containers.

2.1.4 Preparation of ox tail powder

The oxtail was cut into small pieces, soaked in vinegar for 10 minutes this is because vinegar tends to kill salmonella, E coli and other gram-negative bacteria and then boiled in slow heat temperature ranging between 49°C - 60°C for 3 hours until the meat gets tender and it exudes all the fat from the meat. This causes the bones and ligaments to release compounds like collagen, proline, glycine and glutamine which are important. Spices were added to the boiling oxtail, onions, ginger are also added to flavor it and some coriander. After completion of boiling, the oxtail was deboned and further boiled until it becomes a slurry. During boiling the fat separates and comes to the top where it was disposed of. When completely dry it was then taken to an oven to dry it further at temperatures 70°C for 48 hours. It was then ground into smaller particles and packed in airtight container and stored at room temperatures.

2.1.5 Preparation of tomato powder

For tomato powder making, tomato was cut into slices and then cooked. It was then cooled, and the pulp was dried in an oven drier for 3 hours at 60°C. the dried pulp was ground and packaged in airtight glass containers.

2.2 Formulation of Ox-tail, Mushroom-*Moringa* Soup Powder

After drying the products and sieving them, the dried powders were then used to formulate the soup mix in different ratios in combination with other spices and seasonings. Three different formulations of soup mix were prepared using different oxtail powder, mushroom powder and *Moringa* powder ratios as given in the Table 1. Mix 1, Mix 2 and Mix 3 contained different proportions of the ingredients. The soup was prepared by re-constitution of the instant soup mix with water. The obtained mixtures were packed and kept as a stock for further analysis.

Factors that were taken into consideration during formulation was the cost effectiveness of the three major ingredients, underutilization of ox tail, nutritional quality of the combination of three ingredients in a mix in terms of health consciousness, shelf stability of the soup due to the presence of *Moringa* leaf powder and availability of the raw materials.

All other ingredients were in standard proportions except for the three major ingredients that is oxtail powder, mushroom and Moringa leaf powder.

Tomato powder was added to enhance the color of the soup and increase the nutritional quality of the resultant soup. Coriander and salt were included in the formulation to add flavor. Corn starch was included as a thickening agent in the resultant soup. Monosodium glutamate added as a flavor enhancer, it balances, blends and rounds the perception of other tastes. It intensifies the meaty tastes.

2.3 Proximate Analysis

Moisture, ash and fat content were analyzed by standard AOAC methods [13]. Protein content was analyzed using the Kjeldahl. Total carbohydrate content was determined by subtracting the measured protein, fat, ash and moisture from 100. Calorific value was estimated by multiplying the percentages of protein, fat and carbohydrate with their respective physiological fuel value, pH value was determined by a pH meter.

2.4 Rehydration Ratio

Rehydration ratio was performed according to the method outlined by Krokida and Marinou-Kouris [14]. A total of 2 g of 2 different sample of the formulated instant soup powder mix (A and B) were rehydrated using 20 mL distilled water in a shaking water bath at constant temperature in agitation of 100 rpm. After 10 minutes excess water was blotted with tissue paper and the weight was measured. Rehydration ratio was evaluated, the ratio of weight of rehydrated sample to the dry weight of the sample.

2.5 Organoleptic Evaluation of Instant Soup Mix

Formulated instant soup mix was evaluated by conducting an organoleptic evaluation by the method outlined by Dimple and Rohanie [15]. Initially, 50 grams of all the mixes e.g. sample Mix 1, Mix 2 and Mix 3 are taken and mixed with water separately and heated for about 7-10 minutes at 50°C and the sample mixes were also reconstituted with water to determine the difference. Ten panelists were used to evaluate the sensory attributes of soup. The samples were blind-coded by special codes; the panelists were not informed about the experimental approach. They were asked to give a score for each of

color, appearance, odor, texture, taste and overall acceptability while the soup mix was prepared. Then soup was served to the panelists to complete the evaluation of the sensory attributes. The panelists were asked to wash their mouths with warm water between samples.

During flavor evaluation, a nine-point hedonic scale was used with ratings of; 9= like extremely; 8=like moderately; 6=like slightly; 5= neither like nor dislike; 4=dislike slightly; 3=dislike moderately; 2=dislike very much; 1=dislike extremely.

2.6 Reconstitution of the Soup Mix

The optimum condition of the reconstitution of the formulated soup mix was evaluated by conducting preliminary trials. 40 grams of the sample soup mixes were taken and mixed with different amounts of water 400 mL, 500 mL and 600 mL separately and heated on a hot plate. The appearance and consistency of the soup was observed. The optimum amount of water required for reconstitution was based on the evaluation made during observation. There were different ratios of reconstitution which were as follows (1:10, 1:12.5 and 1:15).

3. RESULTS

Tables 2 and 3 show comparison between Nutritional value of fresh and oven dried *Moringa* leaves and the proximate composition of dehydrated *Moringa* leaf (per 100 g leaf powder) before and after analysis respectively.

The nutrient content increases this is due to the drying procedures that make all the nutrients highly concentrated. According to the journal above everything increased when the *Moringa* leaves underwent drying in an oven drier except the moisture content which decreased significantly. Moisture content of powders should be about 10% so as to ensure proper shelf life stability.

In the case of Oyster mushroom powder the fat, ash, protein and total carbohydrates were as follows 2.5%, 8.1%, 31.5% and 40.8% respectively on dry weight basis. Moisture content of the mushroom powder was 3.73% and that of oxtail powder was 4.72%.

In the case of *Moringa* powder the fat, ash, protein and total carbohydrate results were as follows: 6.3%, 9.5%, 33.4% and 57.63% respectively. Its moisture content was 3.1%.

Table 1. Formulation of the soup mix in grams

Ingredients	Mix 1	Mix 2	Mix 3
Mushroom	40	30	20
<i>Moringa</i>	20	22	29
Ox tail	10	15	20
Tomato	9	12	10
Coriander	7	7	7
Salt	1	1	1
Black Pepper	2	2	2
Corn starch	5	5	5
Testing salt (MSG)	1g	1g	1g
Other Seasonings	5	5	5
Total	100	100	100

Table 2. Comparison between nutritional value of fresh and oven dried *Moringa* leaves

Nutrient	Fresh leaves	Oven dried sample
Moisture %	75.9	6
Energy (kcal)	92	271.54
Protein (g)	6.7	23.78
Carbohydrate (g)	12.5	28.32
Fat (g)	1.7	7.0

Table 3. Proximate composition of dehydrated *Moringa* leaf (per 100 g leaf powder) [16]

Iron (mg)	0.85	19
Calcium (mg)	440	3467
Phosphorus (mg)	70	215

Table 4. Results from proximate analysis of the three powders on dry weight basis

Powders	Fat	Ash	Protein	Total carbohydrate	Moisture content
<i>Moringa</i>	6.3	9.5	33.4	57.63	3.1
Mushroom	2.5	8.1	31.5	40.8	3.73
Ox tail	14.6	5.1	23.7	6.2	4.72

Proximate analysis of the sample mixes, Mix 1, Mix 2 and Mix 3 in percentages

	Moisture	Fat	Protein	Ash
Mix 1	3.35%	9.75%	23.8%	13%
Mix 2	2.74%	11.18%	22.65%	14.3%
Mix 3	2.1%	12.05%	20.6%	16.5%

Ox tail powder the results were as follows fat was 14.6%, ash 5.1%, protein 23.7%, total carbohydrates 6.2% and moisture content 4.72%.

Among the different ratios of reconstitution (1:10, 1:12.5 and 1:15). The ratio 1:12.5 was the optimum ratio for reconstituting the soup mixes.

4. DISCUSSION

Development of instant ox tail soup supplemented with *Mushroom* and *Moringa*

leaves is possible, however the moisture content of the three sample mixes varied. Mix 3 had the least moisture content than the other two mixes this is because of the incorporation of increased levels *Moringa* leaf powder in the formulation. This can be supported by the study of [17] which states that an increase in *Moringa* leaf powder reduces the moisture content of bread. Furthermore, low moisture content of *Moringa* leaf powder used in the blends may also substantiate this study and might have implications in terms of the texture and microbiological quality of

soup processed with added *Moringa* leaf powder [17].

The ash content of soup Mix 2 and Mix 3 was higher this is because of the higher added amounts of vegetables and herbs, Mix 3 had the highest ash content this can be attributed to moringa because it contains a lot of minerals [18] and also during formulation mix 3 has the highest percentage of added *Moringa*. *Moringa* has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, *Moringa* leaves can provide 1000 mg and *Moringa* powder can provide more than 4000 mg. The overall results of the ash content were all higher this may be due to supplementation of oxtail-mushroom and *Moringa* leaves which are all good sources of minerals and this is supported by other studies [19]. This suggests that it is a better source of minerals.

The fat content of mushroom powder was 2.94% and that of ox tail was 14.6%. The higher fat content in oxtail is attributed to the higher fat content of ox tail. Mushroom contains lower fat content and if used in its formulation then it can be an ideal low fat diet food that will make the soup an appropriate choice as a food for everybody. *Moringa* contains polyunsaturated fats which include: linolenic, linoleic and oleic acid which have an ability to control cholesterol. This is supported by Saini et al. [20]. Sample Mix 3 had the highest fat content this is because during formulation it had the highest amount of ox tail in it.

Moringa leaf powder contained 59.71% of carbohydrates while that of ox tail was nil. Oxtail contains the least carbohydrates whatsoever. Mushroom powder contains 40% carbohydrates. Mushroom is a good source of high-quality protein (20-40%) on dry weight basis [21]. *Moringa* leaf is also a good source of protein (26%) [22]. Ox tail also contains protein the meat itself. Owing to higher protein content of these two plant sources it could be assumed that addition of soy flour, mushroom, and *Moringa* leaf powder in soup have a greater potential in overcoming protein-calorie malnutrition of the people.

Moringa leaves contain anti-nutrients and the leaves need to be boiled to reduce oxalate and phytate contents significantly, The

presence of phytate and other anti-nutrients can reduce the bioavailability of certain nutrients and processing can hence be done for maximum utilization of required nutrients from the seeds and leaves. Yang et al. [23], reported that boiling increased the availability of iron and antioxidant properties. Better drying techniques should be used to dry the oxtail powder further since it took the longest time to dry it to a level where it could be grinded. The resultant soup mix is to be packaged in soup bags whereby the consumer has ease of use of the product. He or she dips the soup bag in hot water and the flavor and other compounds are simply extracted from the soup bag while the rest of the materials remain inside the soup bag.

4.1 Rehydration Ratio

The rehydration properties, rehydration rate, and rehydration capacity are important characteristics of many products, related to their later preparation for consumption. The rehydration capacity was used as a quality characteristic of the dried product expressed in the rehydration rate RR. When the dried foods reconstituted, it must show acceptable textural, visual, and sensory characteristics, while the rehydration time is minimized.

Rehydration ratio of soup Mix 1 was higher this is because soup mix 1 had the lowest moisture content than the other two samples. Rehydration of soup Mix 3 was lesser because of the particle size of the oxtail powder thus lessened the rehydration procedure.

4.2 Organoleptic Evaluation

The sensory assessment has been performed using the scoring test developed by Sudarsan et al. [24]. The observations were as follows that soup Mix 2 with 15% ox tail powder, 30% mushroom powder and 22% *Moringa* powder secured the highest scores in all attributes and got first rank as "like very much". The second position was soup Mix 3 with 20% oxtail powder, 30% mushroom powder and 29% *Moringa* powder for all quality factors and was classified as "like moderately". Formulation Mix 1 with 10% oxtail powder, 40% mushroom powder and 20% *Moringa* powder also got "like moderately". All the products are similarly acceptable in terms of color but different from one another in terms of flavor and texture. Thus, flavor and texture were the influencing factors during the sensory evaluation. This shows that the overall flavor and

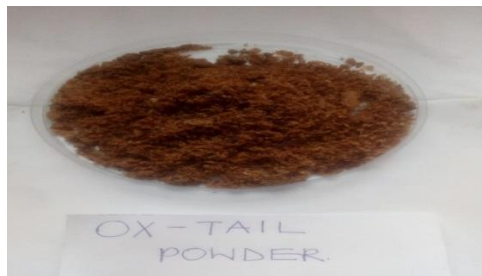
texture were the most important factors influencing overall acceptability of soup.

There were no organoleptic deficiencies observed in all the three formulations, this is because the soup depicted the same characteristics as the original traditional soup only that it scored higher in all quality spheres because of value addition. It should be put into consideration that *Moringa* leaves contain antinutrients and therefore it is advisable to boil the whole leaves before any further processing is done. The presence of phytate and other anti-nutrients can reduce the bioavailability of certain nutrients and processing can hence be done for maximum utilization of required nutrients from the seeds and leaves.

Photos of the soup powders



Mushroom powder



Ox tail powder



Moringa Leaf Powder



Reconstituted soup mix

5. CONCLUSION

The development of the instant oxtail soup supplemented with mushroom and *Moringa* leaves was possible by using the ingredients indicated. It is also important to note that this soup is specifically high in vitamins and proteins and is low in fat which makes the soup an appropriate choice for the fulfillment of nutrition demand in the country; this could play a great role in the alleviation of protein energy malnutrition.

Based on sensory evaluation, the newly developed ox tail-mushroom-*Moringa* soup powder is superior to the locally available soup. This is due to the higher amounts of nutrients and also a good balance of the nutrients.

The least moisture content attributes that the resultant soup mix has a higher shelf life stability of the soup's functionality until its intended use.

It is consumer friendly as individual servings are packaged for consumer use; the amount on the sachet indicates the total amount of powder that will be used to prepare the soup.

This instant oxtail-mushroom-*Moringa* soup may be a great source of nutrition in fast food and alternative of some other animal and plant proteins as value added materials. It can be a good source of value-added food for commercial processed food production. Further study is needed to produce instant oxtail-mushroom-*Moringa* soup mix for a large scale commercial production as well as quality evaluation is also necessary for maintain protein enrichment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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