# Evaluation and demonstration of new food product of enset, orange fleshed sweet potato and finger millet blends for alleviation of nutritional insecurity

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## Abstract

**Both protein-energy malnutrition and micronutrient malnutrition are highly prevalent among infants and children in poor community settings in the developing world, especially the Sub-Saharan African countries. In this study, kocho, bulla, orange-fleshed sweet potato and finger millet were separately processed into their respective flours and blended in a percentage ratio, to prepare household-level. The experiment was done by preparing five formulations of composite flours using Complete Randomized Design (CRD) with three replications at Mierab-Azerinet, Cheha, Enamor-Ener and Gumer districts during 2018-2019. The porridge prepared from blending of bulla, kocho, orange fleshed sweet potato and finger millet flour observed significantly highest value in proximate composition, mineral content and functional properties ($p<0.05$). Porridge prepared from KBP2 (50%, 30%, 10%, 10%) which means bulla, kocho, orange-fleshed sweet potato and finger millet flour products accepted by most panelists for sensory attributes and it was significantly different from the control. The proximate composition revealed that as the proportion of finger millet flour increased, the protein content of the porridge is increased. Protein-energy malnutrition which affects children in case of eating protein low food enset products, can be minimized by blending finger millet flour when porridge preparation. Vitamin A was increased when orange fleshed sweet potato level increased. The blending ratio increased calcium and magnesium increased and zinc content decreased. In conclusion, the developed enset-based complementary foods were found to be of satisfactory nutrient densities and thus can be recommended to be used by infants in low-income communities together with breast milk so as to minimize the adverse consequences of protein-energy malnutrition and micronutrient deficiency complications.**

**Keywords:** Nutritional analyses, Sensory evaluation.

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## Introduction

Enset (*Enset ventricosum*) is one of the indigenous root crops widely cultivated for its food and fiber values in south and southwest highlands of Ethiopia [1]. Enset is a multipurpose crop with all plant parts being utilized for human food, animal forage, medicinal or ornamental uses. The peasants indicate that enset is their food, their cloth, their house, their bed, their cattle-feed and their plate [2]. Enset consists the main fermented food products which is used to human beings daily diets are kocho and bulla in southern and south western parts of Ethiopia [3]. Kocho is the most common bread like staple food product made from enset and is prepared from the pulp of fermented pseudostem and corm. Bulla is the starchy water insoluble product separated from kocho during processing from the pseudostem and is used as porridge or as flat bread. Even though enset is one of the sources of carbohydrates from countries major root crops its low protein and vitamin A content leads to kocho consumption limitation Nowadays, preparing enset flour from kocho and bulla to blend with cereal crops and others roots and tubers is one methods of strategy to enrich low in protein and vitamin A enset food products. Sweet potato is a dicotyledonous plant belongs to the family convolvulaceae and originated in Latin America. It is widely grown throughout tropical and sub-tropical regions [4]. Orange Fleshed Sweet Potato is locally available vitamin A-rich foods that can be grown in home gardens holds particular promise in many places, due to its technical feasibility and cost-effectiveness. Orange fleshed sweet potato (OFSP) can be a very suitable crop to overcoming vitamin A deficiency in East and Southern Africa [5]. Orange Fleshed Sweet Potato flour can serve as a source of energy and nutrients (carbohydrates, beta-carotene (provitamin A), minerals (Ca, P, Fe, and K)), and can add natural sweetness, color, flavor and dietary fiber to processed food products [6].

Finger millet has received considerable attention for their high content of dietary fibres, phytochemicals and nutritional value. Before knowing consumption of finger millet has high human health benefits associated with dietary fibers mostly it is used for animal feeding [7]. Whole grain finger millet contains considerable amount of valuable nutrients such as proteins, starch, unsaturated fatty acids and dietary fiber as soluble and insoluble fractions. Finger millet also contains micronutrients such as vitamin E, folates, zinc, iron, selenium, copper, manganese, carotenoids, betaine, choline, sulphur containing amino acids, phytic acid, lignins, lignane and alkyl resorcinols [8]. Finger millet are processed in order to produce oat based food products such as porridge, finger millet based breakfast cereals, flakes and infant food [9].

Studying the possibilities of increasing enset food product utilization as stable by enriching with deficient nutrients is the basis of the present study. Therefore, this study will be initiated to study the possibility of incorporating oat and OFSP to enset food products kocho and bulla to develop porridge. It is designed to combat malnutrion in the society who consumes enset food products as staple food and to strengthen enset potential both in economic and nutritional terms (Table 1).

## Materials and Methods

***Table 1.*** *Treatments.*

| BP% | Ingredients | | | |
|---|---|---|---|---|
| | **Bulla** | **Kocho** | **Orange flesh sweet potato** | **Finger millet** |
| KBP0 | 100 | - | - | - |
| KBP1 | 50 | 50 | - | - |
| KBP2 | 50 | 30 | 10 | 10 |
| KBP3 | 40 | 30 | 15 | 15 |
| KBP4 | 30 | 30 | 20 | 20 |

### *Nutritional analyses*

Was carried out at Hawassa University FSPT laboratory

### *Sensory evaluation*

The samples were evaluated on the basis of color, taste, flavor, texture and overall acceptability by using 5 point hedonic scale by 50 consumers in each woreda study area community.

### *Kocho flour preparation*

Kocho flour was prepared according to the method used by [9] raw kocho and bulla purchased from local market then squeezed and sieved to reduce fiber then dried for flour process.

### *Porridge preparation*

Porridges were prepared from the composite flour and other essential ingredients (salt, water, and oil). The porridge was prepared with the proportion of water to flour ratio of 6:1. Flours were mixed in a saucepan (pot with handle) to be homogenized with cold water then added in hot water and string continuously for 10 min until the mixed one completely converted into

Porridge, until soft porridge formed. Then it was removed from the stove and allowed to cool to make ready to serve.

Proximate analysis: Moisture, crude protein, crude fiber and crude fat of analysis of product were done in duplicates using the methods described by AOAC method.

### *Carbohydrate*

The carbohydrate content was determined by difference: Utilizable Carbohydrates (%)=100-(Moisture+Protein+Fat +Ash+Fiber)

### *Gross energy*

Values of carbohydrate, protein, and fat obtained in the proximate analysis were multiplied by their respective Atwater's conversion factors (4 kcal/g for protein, 9 kcal/g for fat and 4 kcal/g for carbohydrates).(kcal) Gross Energy 4 kcal Protein 4 kcal Carbohydrate 9 kcal fat/100 gram

### *Data analysis*

Proximate, minerals, functional properties and sensory evaluation data were analyzed using one way analysis of variance (ANOVA) model using the SAS software program, version 9.3.1. The results of these parameters were reported as an average value of triplicate analysis (mean ± SD). Differences between treatments were determined by Fisher's Least Significance Difference (LSD) method and statistical significance was set at $p<0.05$ (Table 2).

## Results and Discussions

***Table 2.*** *Sensory analysis.*

| Treatments | Parameters | | | | |
|---|---|---|---|---|---|
| | **Color** | **Taste** | **Flavor** | **Texture** | **Over all acceptability** |
| KBP0 | 4.44 ± 0.26a | 3.66 ± 0.33bc | 4.00 ± 0.33b | 4.00 ± 0.32ab | 4.11 ± 0.14ab |
| KBP1 | 4.33 ± 0.26a | 4.33 ± 0.33ab | 2.77 ± 0.33c | 3.44 ± 0.32c | 3.67 ± 0.14b |
| KBP2 | 4.34 ± 0.26a | 4.66 ± 0.33a | 4.77 ± 0.33a | 4.40 ± 0.32a | 4.44 ± 0.14a |
| KBP3 | 3.55 ± 0.26b | 3.55 ± 0.33c | 3.00 ± 0.33c | 3.11 ± 0.32c | 3.33 ± 0.14bc |
| KBP4 | 2.78 ± 0.26c | 2.66 ± 0.33d | 2.97 ± 0.33c | 2.56 ± 0.32d | 2.56 ± 0.14d |
| CV | 14.34 | 18.51 | 19.74 | 19.3 | 11.7 |
| LSD | 0.42 | 0.67 | 0.68 | 0.67 | 0.43 |

KBP0=100% bulla, KBP1=50%bulla+50% kocho, KBP2=50% bulla+30% kocho+10% OFSP+10% finger millet, KBP3=40% bulla+30% kocho+15% OFSP+15% finger millet, KBP4=30% bulla+30% kocho+20% OFSP+20% finger millet.

### *Sensory evaluation of the porridge developed from composite flours*

**Color:** The color of the porridge was ranged between 2.78 ± 0.26 (KBP4) to 4.34 ± 0.26 (KBP2). The KBP2 (4.34 ± 0.26) obtained the highest mean score which prepared from 50% bulla, 30% kocho,10% OFSP and10% finger millet flour than

control. The color of porridge showed a significant difference ($p<0.05$). Addition of orange fleshed sweet potato flour increases the color of the porridge. This result agrees with finding on nutritive value and sensory acceptability of corn and kocho-based foods by Abebe et al.

**Taste:** The taste of the porridge was ranged from 2.66 ± 0.33 (KBP4) to 4.66 ± 0.33 (KBP2). Therefore, 4.66 ± 0.33 (KBP2) obtained the highest mean score which prepared from 50% bulla, 30% kocho, 10% OFSP and10% finger millet, than control. The taste of porridge showed a significant difference ($p<0.05$).

**Flavor:** The flavor and smell of the products depend on the volatile constituents of raw material. Flavor of the porridge was ranged from2.2.77 ± 0.33 (KBP1) to 4.77 ± 0.33 (KBP2). The rest comparative results were observed. Therefore, 4.77 ± 0.33 (KBP2) obtained the highest mean score which prepared 50% bulla, 30% kocho, 10% OFSP and 10% finger millet flour than control. The flavor of porridge showed a significant difference ($p<0.05$) and the interaction of blending of composite flour also observed a highly significant difference ($p<0.05$). Similarly, increased flavor score was recorded on the formulation of complementary foods from amaranth, chickpea and maize [10].

**Texture:** The texture of the porridge was ranged from 2.56 ± 0.32 (KBP4) to 4.40 ± 0.32 (KBP2). The, 4.40 ± 0.32 (KBP2) obtained the highest mean score which50% bulla, 30% kocho, 10% OFSP and 10% finger millet flour than control. The texture of porridge showed a significant difference ($p<0.05$).

**Overall acceptability:** In the present study ranking test of formulated porridge results was ranged from 2.56 ± 0.14 (KBP4) to 4.44 ± 0.14 (KBP2). The 4.44 ± 0.14 (KBP2) obtained the highest mean score which prepared 50% bulla, 30% kocho, 10% OFSP and 10% finger millet flour than control. The flavor of porridge showed a significant difference ($p<0.05$). A contrary result was recorded seen in a study conducted on processing technique on physicochemical composition, functional properties and sensory acceptability of quality protein maize-based complementary foods [5] (Table 3).

***Table 3.*** *Proximate analyses.*

| Treatments | | | | Parameters by % | | | |
|---|---|---|---|---|---|---|---|
| | Fat | Protein | Moisture | Ash | Fiber | CHO | Gross energy |
| KBP0 | 5.16e | 3.72d | 7.33b | 2.44e | 4.07e | 77.28a | 370.44a |
| KBP1 | 7.61c | 3.72d | 10.25a | 2.65d | 4.96d | 70.81b | 366.61b |
| KBP2 | 6.66d | 6.44c | 6.19c | 2.77c | 5.01c | 72.93b | 344.12c |
| KBP3 | 8.54a | 8.10b | 5.41e | 2.88b | 6.72b | 68.35c | 339.96c |
| KBP4 | 7.90b | 8.74a | 5.56d | 2.98a | 7.23a | 67.59c | 336.92d |
| CV | 0.15 | 0.19 | 1.17 | 0.38 | 0.18 | 1.21 | 0.8 |
| LSD | 0.019 | 0.012 | 0.14 | 0.018 | 0.018 | 0.8 | 1.3 |

KBP0=100% bulla, KBP1=50% bulla+50% kocho, KBP2=50% bulla+30% kocho+10% OFSP+10% finger millet, KBP3=40% bulla+30% kocho+15%OFSP+15%finger millet, KBP4=30% bulla+30% kocho+20% OFSP+20% finger millet.

### *Proximate composition of porridge*

**Crude fat:** The fat content of the developed composite flour products were varied 5.16% (control) to 7.9% (KBP4). In the results fat content was showed highest value significant difference ($p<0.05$) in the product KBP4 (7.9%) which prepared from Bulla, kocho, OFSP with finger millet. The studied fat content of current study was also higher than the effect of blending ratio and processing technique on physicochemical composition, functional properties and sensory acceptability of quality [10].

Protein maize-based complementary food which was 4.68%.

**Crude protein content:** Above shows that the protein content of the porridge products were in the range from 3.72% (control) to 8.74(KBP4). In this study KBP4 (KBP4%) had highest protein

Content prepared from 30% bulla, 30% kocho,20% OFSP, 20% finger millet flour and control had lowest contents. This indicates that the protein content of product increased with an increase in the proportion of finger millet. This might be due to the high amount of protein in finger millet flour. Therefore, the finding of this study depicted that the addition of finger millet flour is a potential way to increase the nutritional value of traditional Ethiopian food (porridge).

**Moisture content:** As shown in above Table, the moisture contents the study sample KBP1 (10.25%) has the highest moisture content flour than control. And KBP3 (5.41%) had lowest moisture contents which prepared from 40% bulla, 30% kocho, 15%OFSP, 15%finger millet flours than control. A similar result was reported by [5] in the study conducted on the effect of blending ratio and processing technique on physicochemical composition, functional properties and sensory acceptability of quality protein maize-based complementary food. This probably was due to the high water binding capacity of the starch in the food products of bulla flour. Therefore, as the 100% of bulla flour composite products the moisture contents also increased.

**Ash content:** The result in above Table, the ash content ofproducts were ranged 2.44% (control) to 2.98% (KBP4). In this study, the ash content was showed a significant difference ($p<0.05$) in the product composite flour. The ash contents of the products were increased as the increasing level of processed composite flours increased. The studied formulated porridge products ash content value is within the [11] studies, commercially available ensete (*Enset ventricosum* (Welw.) Cheesman) food products, (kocho and bulla) for major minor and trace elements which were ash content value of 1.7%.

**Crude fiber content:** The fiber contents of products were in the range of 4.07% (control) to 7.23% (KBP4). The fiber contents were showed a significant difference ($p<0.05$) in the porridge product. This study value of crude fiber content is higher than the reported study conducted in complementary food prepared from maize and chickpea Anigo et al. This study observation is in agreement with the previous studies value conducted on complementary food prepared from germinated maize and chickpea [12]. Fiber contents of formulated porridge products were higher as the increase processed blending flour than a study conducted in complementary food prepared from quality protein maize [5].

**Carbohydrate:** The carbohydrate content of this study KBP4 (67.59%) had the lowest content prepared from30% bulla, 30% kocho, 20% OFSP and20% finger millet flour than control. The carbohydrate of the product value showed significance difference ($p<0.05$) among the porridge. The Carbohydrate content of the current formulations was more similar to that of reported by Sadana et al. Who found 69.74% carbohydrate from weaning food? The lower carbohydrate contents in the studies could be due to a higher amount of moisture content and other macro nutrients in the composite flours.

**Gross energy:** The gross energy of composite flour products varied from KBP4 (336.44%) to Control (370.92%), In this study KBP4 (336.44 kcal/100 g) had lowest gross energy content in porridge product compared with control.

The gross energy content of the product showed significance difference ($p<0.05$). The energy contents in this study were in the range of 336.44 to 370.92 kcal per 100 gm which can slightly near to satisfy the minimum energy requirements of the recommended daily allowance. A decrease in the gross energy level was observed with an increase in the proportion of composite flour [13-16].

## Conclusion

The complementary food level of addition of 10% KBP2 with acceptability 4.44 sensory qualities was greater than those obtained from control. The more blending used in mixture higher in nutritive value and can be important gain for combating malnutrition enhancing food security. Protein energy malnutrition which affects the children in the case of low protein food bulla can be minimized by blending with cereals when porridge preparation. It is better to OFSP and finger millet flour with kocho and bulla to minimize protein energy malnutrition problem in preschool children.

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