



Proximate Composition and Sensory Properties of Taro (*Colocasia esculenta*) and Wheat (*Triticum aestivum*) Blended Flour Formulated Bread

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Abstract

Blending cereal flour with less utilized nutritious root and tuber crops like taro could have significant impact on improving the chemical composition, sensory quality and overall acceptability of products besides exploiting the underutilized crops. Hence, taro and wheat flour formulation was done to increase the nutritional composition, sensory quality and overall acceptability of formulated bread. Taro is one of the underutilized crop in Ethiopia and it is a good source of carbohydrate. Hence, the objective of this study was done to evaluate taro flour blended with wheat for bread preparation and to familiarize the society with this crop. The formulation was done with D-optimal mixture design to mix wheat with taro and mixing was done by two replication and 10 runs. The levels of taro were in between 50-20% by ratio. Sensory quality analysis was done using 5-point hedonic scale with 1 being disliked very much and 5 like very much. Proximate analysis was done using AOAC 2000 method to determine the organic materials of the products. Data analysis was done using Minitab17. Results indicated that ash, fiber, carbohydrate content, crude protein content of taro and wheat flour formulated bread was improved. However, the moisture content was not shown significant variation.

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Sensory qualities of bread were shown that all formulated breads were accepted by the panelists in taste, aroma, crust color, mouth feel and overall acceptability. Therefore, Blended flour formulated bread can be prepared from taro and wheat with acceptable chemical composition and sensory quality.

Key word: Flour; bread; proximate composition; sensory quality; taro; wheat.

1. Introduction

Taro (*Colocasia esculenta*) L. Schott), a member of the Araceae family is an ancient crop grown throughout the humid tropics for its edible corms and leaves. Taro is a good source of thiamin, riboflavin, iron, phosphorus and zinc and a very good source of vitamin B6, vitamin C, niacin, potassium, copper and manganese. Such as lysine, leucine, isoleucine [1]. Taro also contains greater amounts of vitamin B-complex than whole milk and also it is fairly good source of protein, but rich in carbohydrate, vitamins and the essential amino acids. Despite the high starch content of edible aroids, they have higher content of protein and amino acids than any tropical root crops [2].

Corms of taro supply easily digestible starch and are known to contain substantial amounts of protein, vitamin C, thiamine, riboflavin, niacin and significant amounts of dietary fiber [3]. In addition to this, taro contains some minerals like calcium, vitamin E and B vitamins, as well as magnesium, manganese, copper and fiber. [4] also advice that consumption of micronutrient rich foods such as cocoyam is important for building a strong immune system that help the body to utilize protein, carbohydrates and other nutrients. The leaves contain β -carotene, iron and folic acid, which protect against anaemia are important source of proteins and vitamins which are cooked and eaten as vegetable [4].

The trend of food consumption in Ethiopia is poor; mostly societies are dependent on commonly known foods like "Injera", bread and other foods which are prepared mainly from grains. Due to these majority of peoples specially which are live in rural areas, pregnant and lactating women as well as infants are exposed to nutritional deficiency problems which is the cause of different health problems and mental retardation. Consuming root and tubers, vegetables and different food which are easily available and nutritionally rich can eradicate these problems without any extra cost. From the five year millennium development goals set by the government of Ethiopia food security is the first issue. Our objective will have a positive impact to attain this goal by developing new products from these crops which are nutritionally rich but not comfortable to consume as it is. The main reason which causes a gap in consumption is the way it is prepared for a food.

In Ethiopia the production of taro is low relatively seen with other grains and vegetables but its production has been increasing from time to time. There are different backward factors contributed for the production of taro which make less preferable by consumers. The crop has a sour bitter taste at the back sides of the tongue after consumption. The boiled taro have a mucilage under its external cover which is not accepted specially for new consumers, due to these reasons mostly farmers are using taro for food during the transition period between the previous and the new grain harvesting time(when the scarcity of food occurred) and the peoples with low income level are using it for food. However, this can be improved via composite with common grains such as

wheat and formulated products can be preferable by consumers.

Taro is an underutilized crop in Ethiopia in spite of its widely growing and most nutritious and easily digested foods. More importantly the culture of blending taro with other cereal products to enhance its nutritional and sensory acceptability is weak especially in large scale. Particularly, in Jimma zone taro is prepared as a food in to one product; this is not attracted and invites consumers to eat. Taro is prepared in Jimma by roasting on the hot griddle after it was boiled and peeled. Spices and taste enhancers are not used by societies during taro preparation. This study basically focuses on using taro flour in to different food products by blending with wheat. So, the objective of this study was to improve the availability of nutrients in the taro food with different preparation method so that the societies will incorporate taro in daily foods of societies.

2. Materials and methods

Taro preparation

Taro tubers were collected from Shewarobit integrated research and development farm of Debre Berhan University for bread preparation. The raw taro corms was undergo different physical treatments such as washing, peeling, chopping, soaking, sun drying before they were processed into taro powder to reduce their anti-nutrient contents based on the study of Blasé (2011). Then dried taro tubers were milled using mini laboratory miller in Jimma University, College of Agriculture and Veterinary Medicine, post-harvest department. The flours were packed in polyethylene bags to preserve the row material.

Wheat preparation

Wheat variety which is known as “qaqaba” was collected from Debrezeyit farmers union. Wheat grain undergoes different cleaning procedures and then milled using mini laboratory miller. The wheat flour was packed in polyethylene bag to preserve the product.

Bread preparation

The method used by Okafor and his colleagues (2012) was used with minor modification of baking and fermentation time. A 400g of wheat and taro flour were blended together to prepare formulated bread. Dough was prepared by blending the composite flours with dry 1.6g of yeast, 4g of salt, 12g of sugar, 8g of fat, 8g and brad improver (baking powder) and 400ml of water. Dry ingredients were mixed together by placing in mixer, and then the dough was prepared by kneading the mixed ingredients with water for 15min.

Proofing was under taken for 1hr and 30min under oven at 32°C and the dough was divided, knocked back and shaped. After the dough rise it was turned onto a lightly floured surface and gently degassed by pressing the dough. The dough was divided into the required size piece; the pieces were shaped into round balls. Then dough was covered and allowed to rest for final proofing. It was left to rise under oven (for 1hr at 30°C). Bread was baked in hot oven set at temperature of 240°C for 45min until the crust turns golden and baked well.

Table1: constraints used for bread formulation

Std	Run	Component A: wheat	Component B: Taro
1	1	60	40
2	2	70	30
3	3	60	40
4	4	90	10
5	5	50	50
6	6	50	50
7	7	90	10
8	8	80	20
9	9	70	30
10	10	80	20

Data collection

Sensory evaluation

Sensory evaluation was conducted by using randomly selecting 50 semi-trained panelists where they are from JUCAVM post-harvest post graduate students and staff members. Samples were presented in identical sample presenting dishes coded with 3-digit random number with a sensory data ballot paper. The results were obtained by giving a score using 5 point Hedonic scales with 1 being dislike very much and 5 like very much. The order of presentation of the samples to the panel was randomized according to (Ihekonronye and Ngoddy, 1985).

Proximate composition

Moisture: method number 925.05 of the AOAC (2000) was used to determine the moisture contents of the samples. The dishes were dried at 130⁰C in drying oven (dry oven, DHG-9240A. shanghai) for one hour and placed in desiccators for about 15-20 min. The mass of the dish was measured (M1). About 2-3 g of the sample was weighed into the moisture dish (M2). Then the sample was dried at 100 °C for 6 hrs. After drying was completed, it was measured as M3.

Moisture(%) = $\frac{M3-M1}{M2-M1} \times 100\%$ Where, M₁= weight of dish, M₂= weight of dish plus fresh sample and M₃= weight of dish plus dry sample

Total ash: AOAC (2000) method number 941.12 was used to determine the total ash. Porcelain dish was cleaned and dried in an oven at 120 °C. Then, samples were ignited at 550 °C in a Muffle furnace for 12 hrs. Then the dishes were removed from the furnace and cooled in desiccators. The mass of the dish was weighed (M1) using analytical balance. About 5g of the sample was weighed in to porcelain dish (M2).The sample was dried at

120°C for one hour in a drying oven.

Ash(%) = $\frac{M_3 - M_1}{M_2 - M_1} \times 100\%$ Where, M_1 is mass of crucible in g, M_2 is mass of crucible and sample in g before ashing and M_3 is mass of crucible, the sample and ash after ashing in g.

Dietary fiber: crude dietary fiber was determined following (AOAC, 2000, 920.169). About 1.5g of the sample was weighed. If the sample contains fat > 1%, the fat was extracted by diethyl ether:- by replacing 0.25-0.5g bumping granules, followed by adding 200ml of 1.25% sulfuric acid solution to the beaker near-boiling. The sample in the beaker was boiled for 30min by swirling it periodically. Near the end of refluxing, it was placed in Buchner funnel fitted with rubber stopper and filtered. At the end of filtration the solids were washed by distilled warm water and 1.25% sodium hydroxide solution. The filtration continued until dry. The residue was, dried for 2h at 130°C, cooled in the desiccators and weighed (M_1). Then ignited and ashed at 550°C in a furnace, cooled in desiccators and weighed (M_2). Finally the crude fiber percentage was calculated as follows:

$$\text{Crude fiber(\%)} = \frac{M_1 - M_2}{\text{weight of sample}} \times 100\%$$

Crude protein: Crude protein was determined using Kjeldahl method as described in AOAC (1990). About 0.3g of ground sample (1mm sieve size) was weighed in to Kjeldahl digestion flask (distillation device, KDN-F, shanghai) and catalyst mixture (K_2SO_4 mixed with $CuSO_4 \cdot 5H_2O$ in the ratio of 1:10) was added in to each flask. Then, 10 ml of concentrated H_2SO_4 (98%) was added and the sample was digested at a temperature of 420°C for about 3 hrs until the solution was clear white. With the completion of digestion (when the digested sample becomes colorless or light blue) the samples was allowed to cool. After the samples were cooling, 30ml of distilled water was added in to each digestion flask followed by 25ml of 40% NaOH. Immediately the content was distilled by connecting the digestion tube line in to the receiver flask that contains 25 ml of 4% boric acid solution. The collected ammonia distillate was then titrated against a standardized 0.1N HCl until the end of the titration is attained (where the titration color changes from green to purple). Then the volume of HCl consumed to reach the titration end point was read from the burette and the nitrogen content % was calculated as follows:

$N(\%) = \frac{N_{HCl} \times (V_{HCl} - V_{Blank}) \times 14.007}{\text{sample weight} \times 10}$ Where V_{HCl} is volume of HCl in liter consumed to the end point of titration, N_{HCl} is the normality of HCl used. V_{Blank} volume of blank used for titration.

Crude Fat:- About 3g of sample was weighed and put into a thimble lined with a circle of filter paper according to method number 4.5.01 of the AOAC 2000. The thimble and contents were placed into a 50ml beaker and dried in an oven for 2h at 110°C. Thimble and contents were transferred in to extraction apparatus (fat determinator, SZC-C, Shanghai). The beaker was rinsed several times with diethyl ether. The samples contained in the thimble were extracted with the solvent diethyl ether in a Soxhlet extraction apparatus (2055 soxtec, sweden) for 2:30 hr. At the completion of the extraction, the extracted was transferred from the extraction flask into a pre-weighed evaporating small beaker (150-250ml) by rinsing with the solvent several times. The diethyl ether was evaporated until no odor was detected. The beaker and contents were dried in an oven for 45min at 100°C. Then the beaker was removed from the oven and cooled in a desiccators. The beaker and its contents

were weighed.

$$\text{Crude fat}(\%) = \frac{M1 - M2}{\text{weight of sample}} \times 100\%$$

Crude carbohydrate: total carbohydrate was determined by difference according to AOAC (1990) with the exclusion of crude fiber.

$$\text{Total CHO} = \text{Total sample food} - (\text{Crude fiber} + \text{Total fat} + \text{Moisture} + \text{Ash})$$

Data analysis

Bread preparation was done from wheat-taro formulated flour. The formulation was done using D-optimal mixture design. In the combination the percentage of taro was in between 10-50%. The data was analyzed using minitab17 software package. Significant differences in proximate composition and sensory evaluation was identified at (P<0.05), descriptive statistics was used for organizing and presenting the data.

3. Result and Discussion

Proximate composition of bread

Ash: the ash content of bread with taro was increased with the increment of taro in the formula which was consistent with the result of [5]. In similar to the current results [5] the ash content of bread with taro was increased with the increment of taro in the formula. The findings of [6] also shown that increase of substitution ratio of wheat flour with taro flour resulted in an increase in ash content from 0.95 to 2.15. Correspondingly, [7] also reported that the ash content was increased with increased sweet potato flour substitution of maize which showed that blending cereal flour with root and tuber crops can enhance proximate composition. In this regard, the possible increment of ash content with increasing taro could be due to the fact that taro is rich source of minerals and it is imperative to blend wheat flour with it to enhance the mineral content.

Table 1: Mean value for proximate composition of bread from wheat and taro

Treatment	wheat%	taro%	mc%	ash%	protein%	fiber%	fat%	CHO%
T1B	60	40	9.2	22.0	1.08	10.58	2.04	63.7
T2B	70	30	9.2	19.8	1.15	8.33	0.75	84.1
T3B	60	40	9.1	21.5	1.27	9.73	1.87	70.8
T4B	90	10	9.1	16.8	1.3	6.47	2.3	66.3
T5B	50	50	9.3	24.4	1.16	11.23	1.54	72.0
T6B	50	50	9.3	24.9	1.23	11.67	1.09	65.4
T7B	90	10	9.3	17.0	1.16	6.97	2.18	67.4
T8B	80	20	9.4	18.9	1.23	7.9	2.59	64.8
T9B	70	30	9.2	19.2	1.19	8.77	1.99	85.4
T10B	80	20	9.3	18.1	1.27	7.53	2.17	71.3

Mc= moisture content CHO= carbohydrate

Carbohydrate: As shown in Table 1, the carbohydrate content of taro and wheat blends varied from 63.7% to 85.4% in 30% taro and 40% taro respectively. Carbohydrate content was increased with increasing the amount of taro up to 30% and then declines when the percentage of taro increases. The level of carbohydrate increased up the amount of taro reaches 30% and then declines when the percentage of taro increases. Similar finding was reported by [5] where the level of available carbohydrates in the whole wheat bread drops slightly as the amount of taro increased up to some level. The relative increase of carbohydrate could be due to the fact that taro has high carbohydrate content than cereals. In accordance to this fact [8] reported that taro is known to be a good source of carbohydrate, fiber, minerals especially potassium and vitamins (primarily B-complex) which is more than that found in whole milk and vitamin A and C. Generally, [9] generalized that cocoyam, cassava, taro and other tuber crops have been found to be alternative sources of major raw materials for bread making.

Percentage of Crude Protein: percentage of protein content was shown in Table 1. Results of analysis of variance revealed that bread with 10% taro and 90% wheat blend had shown the highest protein percentage (1.3%) than other blending ratio. [10] Who suggested that in order to guarantee the quality of bread made from wheat–taro composite the level of taro addition should not exceed 10 %. In similar manner, the findings of [6] also shown that more of substitution ratio of wheat flour with taro flour resulted in decreasing of crude protein and ether extract of the bread samples indicating that appropriate blending ratio is more worthy. Therefore, supplementation of wheat flour with inexpensive staples such as taro could help to improve the nutritional quality of wheat products provided that appropriate blending ratio is maintained.

Percentage of fiber: the percentage of fiber content of bread was also increases with the level of taro and wheat blending. The percentage of blending was varied from 11.67 to 6.47 in 50% taro and 10% taro respectively (Table 1). The increased fiber contents could be attributed to the taro flour which is rich in minerals and fiber. This important advantage, since, fiber aids in digestive process, makes elimination of stool easy and also helps in cancer prevention [4]. Also reported that high fiber helps to enhance the gastrointestinal tract health and normal bowel movements thereby reducing constipation problems [11].

Percentage crude Fat: As shown in Table 1 percentage of fat was rages from 2.59% in 20 % taro to 0.75% in 30% taro. According to [12], plant fat is a good source of energy and helps in absorption of most fat soluble vitamins and minerals. However, since, content of fat is varied among plant species blending might be varied the fat composition of products. [13] Reported that fat content of wheat flour is generally low but much higher than in taro flour which means that blending with taro flour may help to improve the fat content of bread made from taro flour. This could be due to the variation in variety, production agro ecology and pre-harvest and post-harvest management of the crops.

Moisture content: Moisture content of food is important parameter since it talks about the microbial reaction. There was no visible difference measured in the amount of moisture content when taro and wheat flour blended bread was analyzed. It was ranged from 9.1-9.4% which is in similar with [7] who reported blends of maize and sweet potato flour was not shown significant moisture change. In the contrary [13] reported that significant attribute imparted to bread by taro flour was its increased moistness and keeping quality, resulting from exceedingly high absorption of liquid by wheat–taro composite flour and generalized that superior quality of

wheat–taro may result from the initial high moisture capacity, due to the fairly high percentage of mucilage in taro flour. But this fact was not shown in this investigation which could be due to the variation of the taro and wheat varieties used.

Sensory quality of bread

Sensory qualities of bread were shown that all formulated breads were accepted by the panelists in all parameters. Large values were more preferred among formulated flour breads than small values. Generally, the result was not affected by the ratio of taro-wheat combination. The preference of bread taste which is the sweet sensation and aroma of the panelists were high in low level taro. Consistency to the current results, [14] also reported that on total score for volume, colour and character of the crust, texture and grain, crumb colour and taste decreased as the concentration of cassava flour increased in cassava-wheat blending. In consistency to the current results researches in wheat-cassava blending, similarity were observed in bread aroma made with 100% wheat flour, 10% and 20% non-fermented cassava flour [15]. Likewise, [15], no significant differences from bread made from 100% wheat flour and the bread made with 10% substitution of fermented cassava flour. Color of bread invites consumers either to like or dislike and talks about the appearance of the bread. Crust color was high in 10% to 20% taro (Table 2). In harmony to the current results [5] also reported that panelists prefer the colour of panelists for the sensory attributes of the wheat flour taro-based bread to that of the whole wheat bread. Like the current results, [15]reported that aroma and taste of bread made from the 100% wheat flour was comparable to the bread made from the substitution levels of 10% fermented and 20% non-fermented cassava flour. But, the air cell was high in 50% and 40% taro. Mouth feel was highest in 10% taro followed by 20% and 30% taro. Correspondingly, [6] found that organoleptic properties of the bread samples which made of blends containing up to 10 % taro and 90% wheat flour had organoleptic properties (appearance, separation of layers, roundness, crumb, crust color, taste, odor, overall acceptability and average overall acceptability) similar to that of control (100% wheat). This fact proven that taro plant can be fully exploited and popular in countries like Ethiopia where food security is the common problem.

Table 2: Mean values for sensory quality of bread

Treatment	Wheat (%)	Taro (%)	Taste	Aroma	Crust Color	Air Cell	Mouth Feel
T1B	60	40	3.6	3.6	3.2	3.7	3.3
T2B	70	30	3.6	3.4	3.4	3.5	3.7
T3B	60	40	3.5	3.4	3.4	3.4	3.3
T4B	90	10	3.8	3.6	3.8	3.1	3.4
T5B	50	50	3.4	3.2	3.1	3.2	3.2
T6B	50	50	3.6	3.6	3.5	3.8	3.4
T7B	90	10	4.2	4.0	4.0	3.7	3.8
T8B	80	20	4.0	3.6	3.8	3.5	3.7
T9B	70	30	3.8	3.7	3.3	3.3	3.6
T10B	80	20	3.9	4.1	4.3	3.9	4.0

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