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Sensory Quality of Bread from Germinated Maize (*Zea mays L.*), Soybean (*Glycine max* L Merrill) and Moringa (*M.stenopetala*) Leaf Powder

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Abstract

Food formulation is fundamental meaning is the putting together of components in appropriate relationships or structures, according to a formula. The objective of this study was to measure the sensory quality of bread prepared from germinated maize, soybean and moringa. The sample diets were formulated with different proportions and the formulation were prepared using design expert (D-optimal design) with 16 runs. The bread formula were (flour 400g, dry yeast 1.6g, salt 4g, sugar 12g, fat 8g, bread improver 8g, water 400ml). Fermentation time was 1½hr at 30-32^{0}C, proofing time 1hr at 30°C, baking time 45 min at 240°C. Standard procedures were used to determine the principal parameters in formulated bread. The optimum point for sensory evaluation was at maize 75.7%, soybean 17.5% and moringa 6.8%. With sensory result of taste 7.2%, aroma 6.6%, crust color 6%, air cells 7% and mouth feel after taste 8.5%.

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1. Introduction

Bread is among the staple foods of the Ethiopian population. It is consumed almost by all Peoples in the country. It is commonly consumed in both rural and urban areas. In most parts of the country, bread is prepared from wheat flour. According to [1], the word bread is used to describe the whole range of different bread varieties which may vary in weight, shape, crust hardness, crumb cell structure, softness, color and eating quality. Maize, which is a cereal widely grown in Ethiopia, is not usually utilized for bread making except in some areas of the country [2].

Food formulation is fundamental meaning is the putting together of components in appropriate relationships or structures, according to a formula. Product development is a basic activity in the food industry. The product development program encompasses product improvement, product line extension and product re-launch, as well as product innovation.

The quality of food products, in conformity with consumer requirements, is determined by sensory attributes. Sensory evaluation has been defined as a scientific method used to suggest, measure, analyze and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, hearing[3].

1.1 Objectives

1.1.1 General objective

To measure the sensory quality of bread formulated from germinated maize, soybean and moringa leaf powder

1.1.2 Specific objectives

- To evaluate the acceptance of consumers for the formulated bread
- To select the best formula based on the sensory evaluation done

2. Materials and Methods

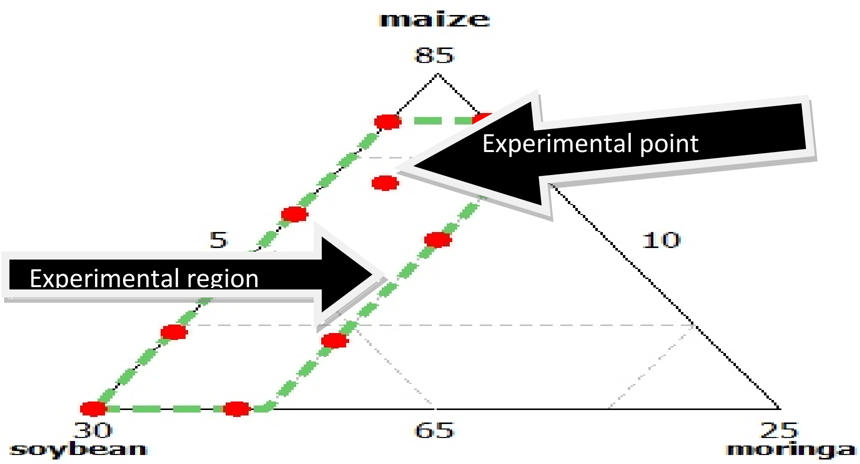
2.1. *Experimental design*

The formulations were obtained based on a constrained mixture D-optimal design. Table 1 presents sample codes and actual proportion of ingredients used. Totally there were 16 sets of experimental combinations.

The food formulation work and sensory quality analysis were conducted at the post harvest laboratory of Jimma University located at Jimma, Ethiopia.

Table1: Constraints used for formulation

Std	Run	Component A: Maize (%)	Component B: Soy bean(%)	Component C: Moringa (%)
1	12	76.65	18.35	5.00
2	11	65.00	30.00	5.00
3	15	82.11	12.90	5.00
4	13	82.11	12.90	5.00
5	4	69.60	25.40	5.00
6	1	78.50	14.72	6.70
7	14	72.90	20.20	6.90
8	5	72.90	20.20	6.90
9	3	72.90	20.20	6.90
10	16	82.20	10.00	7.80
11	9	82.20	10.00	7.80
12	2	65.00	25.80	9.20
13	7	65.00	25.80	9.20
14	10	78.40	11.60	10.00
15	8	75.10	14.90	10.00
16	6	69.10	20.90	10.00



Constraints region

$65 \leq A \leq 82.2$

$10 \leq B \leq 30$

$5 \leq C \leq 10$

Figure1. The region and points for experiment obtained from each constraint

2.2. Sample Collection and Preparation

Maize variety BH-660 and Soybean variety “Clark” was purchased from Jimma maize and Soybean seed producer farmers who was working in contact with Jimma Agricultural research center. The leaves of Morniga stenopetalea tree were obtained from Alagea College of Agriculture situated at Shashemene, Ethiopia.

Maize

Maize samples were prepared following the procedure outlined by [4]. Cleaning of maize was done to remove dusts, stones, debris, broken kernels dead insects and other contaminants manually. Clean Maize grains were washed in a 5% (w/v) **sodium chloride** (NaCl) solution to suppress growth of moulds. Then steeped using tap water at room temperature (30±2°C) in a ratio of 1:3 (w/v) grains: water in plastic buket for a total of steeping time of 12hr with minor modification of soaking time. Germination was achieved by spreading the soaked seeds on moistened jute bags placed under a growth champer set at 32^0C for 24hr. The germinated grains were dried under electric oven at 70^0C for 18hr and milled using(heavy duty cutting mill, SM200/698upm,Germany).

Soybean

The preparation of soybean samples was in accordance with the work of [5]. Soybean grain was boiled for 30min, followed by washing to remove the husk from the beans. Oven drying was done at 60°C for 16h with minor modification of time and temperature used for boiling and drying. The dried sample was milled using (heavy duty cutting mill, SM200/698upm, Germany) miller.

Moringa

The fresh leaves were washed and dried on a clean sheet under the shade by occasionally turning it to obtain uniform drying and to prevent browning and off odor. After the leaves were dried the stems removed and milled using(heavy duty cutting mill, SM200/698upm, Germany) in the laboratory.

2.3. *Bread making*

The method used by [6] was followed with minor modification of baking and fermentation time. 400g of germinated maize flour, soybean flour and moringa leaf powder were blended together to prepare formulated bread. The dough was prepared by blending the composite flours with dry yeast 1.6g, salt4g, sugar 12g, fat8g, bread improver(baking powder) 8g,and water 400ml. dry ingredients were mixed together by placing in a mixer, and then the dough were prepared by kneading the mixed ingredients with water for 15min. The proofing were undertaken for 1hr and 30min under oven at 32°C. The 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. Then dough was divided into the required size pieces, 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 at30^0C). the bread was baked in a hot oven set at a temperature of 240°C for 45min until the crust turns to golden and baked well.

2.4. *Sensory analysis*

Sensory evaluation was conducted by using randomly selecting 50 semi-trained panelists from JUCAVM post harvest post graduate students and staff members. The panelists tasted the samples for air cells, aroma, taste, mouth feel after taste and color of the bread samples. The bread crust color, air cells were evaluated visually by the panelists. The 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 [7].

3. Result and Discussion

The sensory quality parameters evaluated by randomly selected semi-trained panelists were mouth feel after taste, air cells, crust color, aroma and taste. The mean values given for a taste was in between 3 to 4.5. The acceptance of a taste for formulated bread was increased with the increased level of soybean content in the formulated bread (figure2). Taste has statistically a significant difference ($p< 0.05$) to show the effect of soybean on the acceptance of taste in the formulated bread. The Analysis of Variance shows that the fitted model was not significant ($p>0.05$). The fitted model equation for taste was shown below on Eq.1.

$$\text{Taste} = 9.4A+15.6B+570C-19.2AB-693.2AC-573.8BC \quad (1)$$

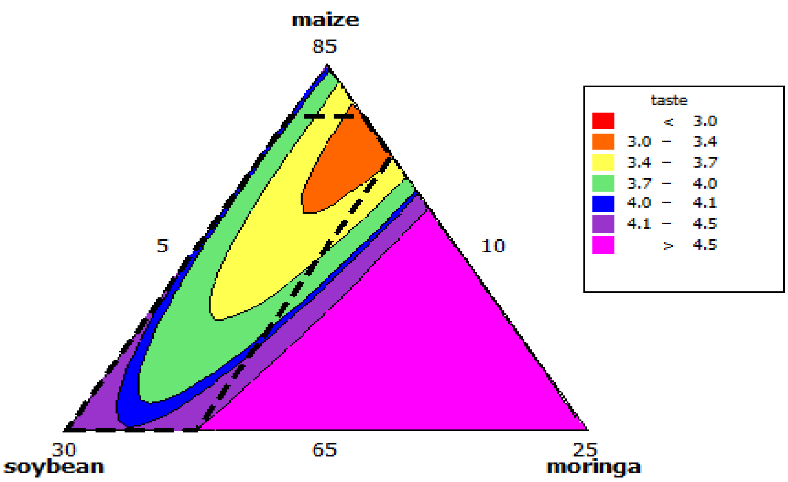


Figure2. Contour plot for taste

Aroma is mostly found in foods and some beverages like wine. Aroma was developed when chemical compounds was sufficiently volatile and to be transported to the olfactory system in the upper part of the nose. Aroma was not significant ($p> 0.05$) for the formulated bread. The mean values for aroma was in between 2.5 and 4 (Figure3). The preference for aroma was not directly related with the constraints used for the formulation. It was an important parameter when testing the acceptability of formulated foods. The Analysis of Variance shows that lack of fit for the fitted model was not significant (p>0.05). The fitted model equation for aroma was shown below on Eq.2.

$$Aroma = 4.4A + 0.3B + 157.4C + 6.2AB - 168.9AC - 244.9BC \quad (2)$$

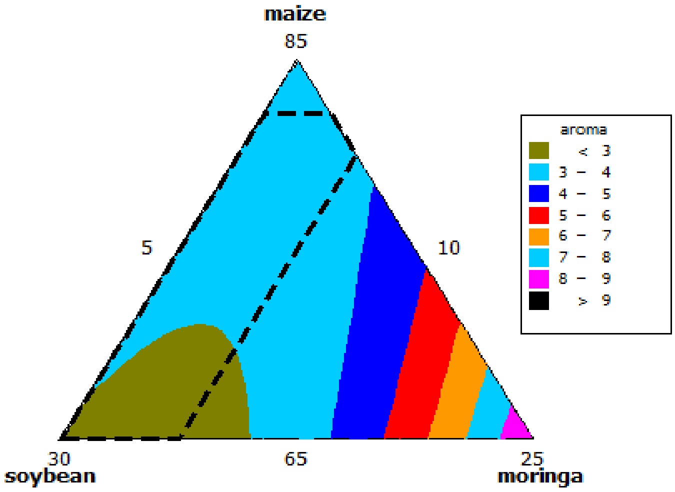


Figure3. Contour plot of aroma

The preference for crust color was significant (p < 0.05) for composite flour bread. The color of the crust have a golden brown color and an attractive appearance for the bread with higher proportion of soybean content. The panelists preferred the bread with a higher level of soybean content in the formulated bread. The mean values for aroma was in between 2.5 to 4 for formulated breads (Figure 4). The brown color development on bread crust was due to Millard reaction occurred at the baking time of bread. Millard reaction depends on the temperature, time, pH, water content and on the type of sugars and amino acids involved [8]. The lack of fit for the fitted model was not significant (p>0.05), the fitted model equation for crust color was shown on Eq.3. Similarly flavor and aroma development also occurred due to the Millard reactions.

The developments of bread air cells were low when compared with bread from wheat with gluten content. The all the constraints used for a formula bread were lower in its gluten content. Low gluten foods were selected for the consumers who have a problem with gluten intolerance, which can be defined as affecting the immune system and having an immediate reaction upon ingestion. The most common food allergens, which were responsible for up to 90 % of all allergic reactions, were the proteins in cow milk, eggs, peanuts, wheat, soy, fish, shellfish and tree nuts [9]. The values given by the panelist for bread air cells were in the range of 3 to 4 (Figure 5). The preference of formula bread for its air cell was increased with the increased level of maize in the formulation. The ANOVA shows that there is no statistical difference in the values of air cells, bread air cells was not significant (p> 0.05) to show the effect of maize on the development of air cells for composite flour breads. The lack of fit for the fitted model was not significant (p> 0.05) to demonstrating the adequacy of the model, the fitted model equation for air cells was shown in Eq.4.

Crust color= 3.5A+15.6B+184.7C-11.1AB-217.6AC-193.5BC (3)

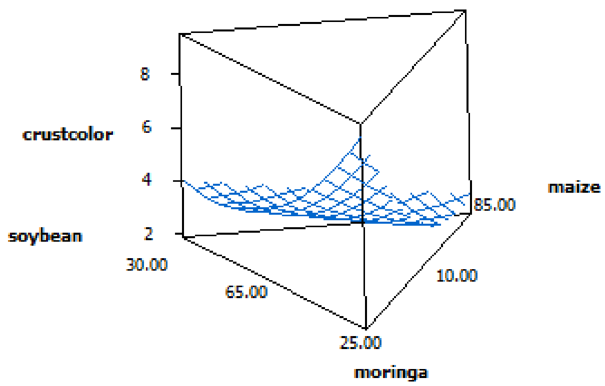


Figure4. Surface plot bread crust color

Air cells= 5.75A+6.68B+22.52C-13.58AB-32.63AC-6.59BC (4)

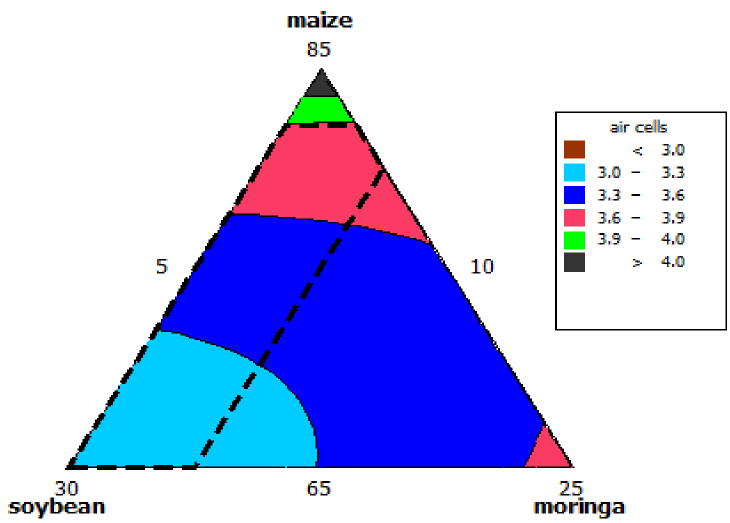


Figure5. Surface plot for bread air cells

Mouth feel is a technical term which is used to discuss the chemical and physical interactions of food with the mouth. It was a sense recognized after tasting any food either it is good or not. The mean values for mouth feel after taste was in between 3.6 and 4.8 (Figure 6). ANOVA shows that the scored values for mouth feel after taste was not significant (p >0.05) for breads from composite flours to show the effect of maize on the formulated bread. The lack of fit for the model was not significant (p >0.05), the fitted model equation for mouth feel was shown on Eq.5.

$$\text{Mouth feel}=3.3A-5.3B+530.4C+51.9AB-574.9AC-861.5BC \quad (5)$$

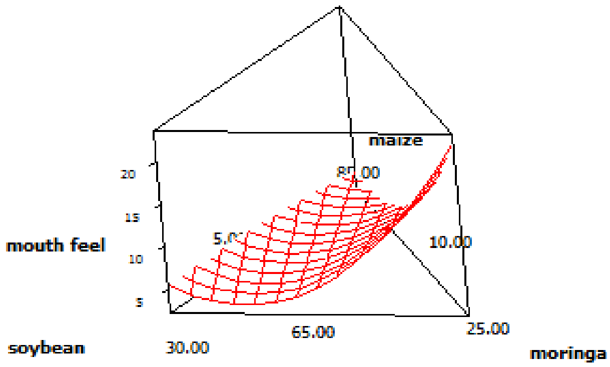


Figure6.surface plot of preference in mouth feel after taste

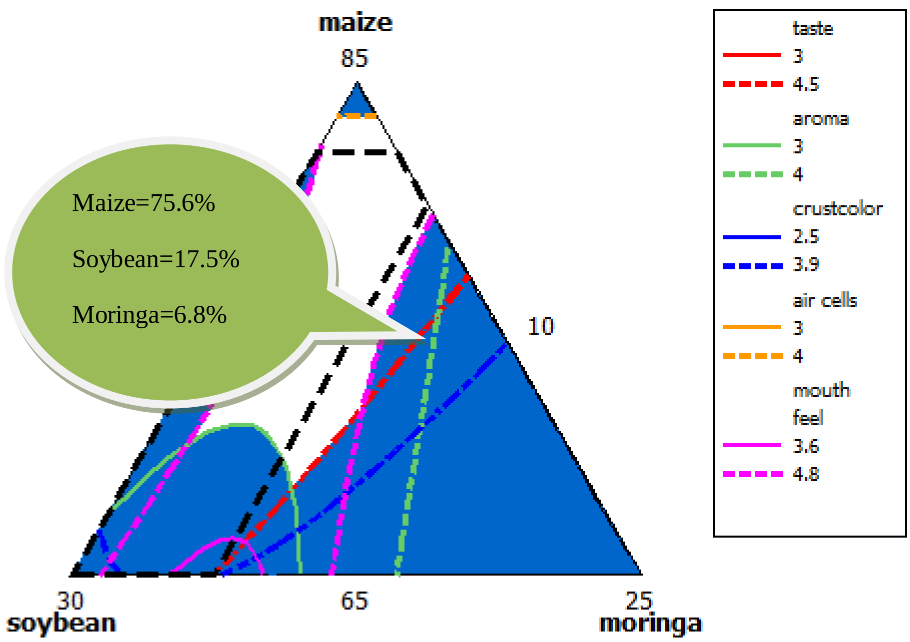


Figure7. Overlaid plot for sensory evaluation

4. Summary and conclusion

The optimum points for sensory quality was at composition ratios of maize 75.6%, soybean 17.5% and moringa 6.8%, which was selected by the panelists for taste 3.6, aroma 3.3, crust color 3, crumb size and holes/air cells 3.5, and mouth feel after taste 4.3. In general the optimum point selected by the panelists for sensory evaluation was better in its physical and sensory qualities compared with the rest.

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