

# Evaluation of Baking Properties and Sensory Quality of Wheat-Cowpea Flour

Mohamed A. Ahmed, and Lydia J. Campbell

**Abstract**—The fortified of soft wheat flour with cowpea flour in bread making was investigated. The Soft wheat flour (SWF) was substituted by cowpea flour at levels of 5, 15 and 20%. The protein content of composite breads ranged from 6.1 – 9.9%. Significant difference was observed in moisture, protein and crude fibre contents of control (wheat bread) and composite bread at 5% addition of cowpea. Water absorption capacities of composite flours increased with increasing levels of cowpea flour in the blend. The specific loaf volume decreased significantly with increased cowpea content of blends. The overall acceptability of the 5% cowpea flour content of composite bread was not significantly different from the control (Soft Wheat-bread) but there is significantly different with increasing the levels of cowpea flour in the blend more than 5%.

**Keywords**—Cowpea flour, wheat flour, baking properties, sensory quality.

## I. INTRODUCTION

**C**OWPEAS (*Vigna unguiculata* L) are a legume grown extensively in Libya and many Northern African countries as an important protein source. As estimated by Food and Agricultural Organization (FAO), farmers cultivate cowpea in the range of 12.5 million hectares in the world of which 8 million are in Central and West Africa. Annual global production is over 3 million tones [1]. The legume is processed and consumed in a variety of ways, depending on traditional practices and taste preferences. The seeds are boiled alone or in combination with some foods. It could also become an important ingredient in many food applications such as baked foods [2]. Cowpeas, also known as black-eyed peas, southern peas, or crowder peas are underutilized in the United States and other industrialized countries. This is due in part to storage induced textural (hard-to-cook) defects and the presence of certain antinutritional factors and nondigestible components [3]. They are processed and consumed in a variety of ways, depending on traditional practices and taste preferences.

Traditionally as in North of Africa, the seeds are boiled alone or in combination with other foods. Because of the potential of cowpeas as a cheap source of significant amounts of protein, calories, and B vitamins such as folacin, niacin, and riboflavin, they should be considered as a valuable food ingredient. The objective of this study was to investigate the effect of addition of cowpea flour on the baking properties of wheat flour.

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## II. MATERIALS AND METHODS

### A. Materials

Cowpea seeds were from a local store in Edinburgh. Cowpea flour was obtained by milling the samples in a lab mill. The Soft wheat flour used was obtained from Azda Supermarket in Edinburgh City, UK.

### B. Methods

#### 1. Bread making

Flour samples containing wheat and cowpea flours were formulated at 0, 5, 15 and 20% (w/w) level of cowpea flour substitutions for bread making.

#### 2. Proximate composition

Proximate analyses of the samples ie moisture, crude protein, ash and crude fat, were carried out according to American Association of Cereal Chemists (AACC) [4] methods 44-19, 46-12, 08-01 and 30-26 respectively. Carbohydrate was calculated by difference. All results are expressed on a wet basis.

#### 3. Preparation of bread

Straight dough method 10-10B of AACC [4] was used to bake bread, according to the recipe indicated in table I. Doughs were prepared from wheat flour with and without the addition of different additives of cowpea flour.

The ingredients were mixed for five minutes. The dough was baked at 215°C for 30 min., in a pan loaf in Russell Hobbs Mini Oven as shown in Fig. 1.

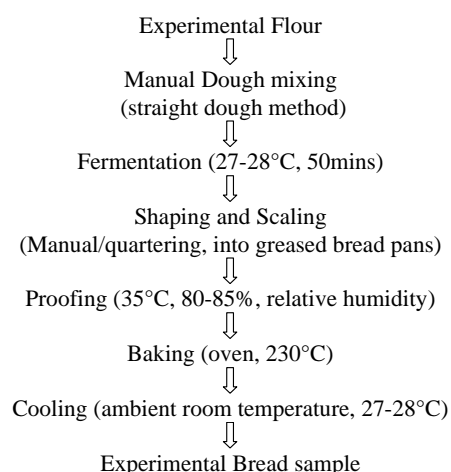


Fig. 1 Flow chart for the production of the bread sample

#### 4. Water absorption capacity

Water absorption properties of the composite flour were determined following method of Sathe et al. [5].

#### 5. Bread quality evaluation

Loaf volume and specific loaf volume were measured following methods of Giami et al [6]. Sensory evaluation was performed 24 hours after baking to evaluate loaf appearance, crust colour, crumb colour, taste/ flavor and overall acceptability of the bread sample. The bread samples were sliced into pieces of uniform thickness and served with water. To perform the evaluation, Panelists evaluated bread samples on a 9 point hedonic scale quality analysis [7] with 9 = liked extremely, 8 = liked very much, 7 = liked, 6 = liked mildly, 5 = neither liked nor disliked, 4 = disliked mildly, 3 = disliked, 2 = disliked very much and 1 = disliked extremely .

#### 6. Effect of cowpea flour on textural properties of bread

Crumb hardness as texture measurement was determined after 1 hr cooling and during storage on the Zwick/Roell type Z010 machine. AACC method 74-09 [4] was used to measure the hardness of crumb.

#### 7. Statistical analysis

Calculation of the significance of differences in test results was performed by the F-test and the least significant difference test (LSD) at the 5% significance level [8].

### III. RESULTS AND DISCUSSION

The protein contents of wheat and cowpea flours were 9.7% and 25% respectively. Differences in the nutrient contents of 0% (control), and 5% level of cowpea flour were significant ( $P > 0.05$ ) except lipid and ash. The protein contents of the composite breads ranged from 6.1 – 9.9%. Protein contents increased significantly with increasing levels of cowpea flour in the composite flours. Water absorption increased with increasing contents of cowpea in the blends.

Figure 4 presents the average results of sensory attributes of cowpea flour addition. As can be seen, difference in the overall acceptability of 0% (control), and 5% level of cowpea flour was insignificant ( $P > 0.05$ ) On the other hand, results showed that cowpea flour incorporation at the level of 20% led to a poorer overall acceptability. Cowpea flour increased the hardness of the bread crumb and decreased the specific volume of breads, whilst 5% level of cowpea flour decreased the specific volume of bread but crumb hardness remained similar to the control up to three days. It must be mentioned that cowpea flour showed increased in crumb moisture. This could indicate a positive trend as increased crumb softness might relate to the moisture retention capacity.

TABLE I

INGREDIENTS FOR MAKING BREAD	
Component	Bread composition (%)
Flour*	100
Yeast	1.0
Sugar	3.0
Salt	1.0
Fat	5.0
Ascorbic Acid	75ppm
Water	54.5

\*Wheat or wheat-cowpea composite flour.

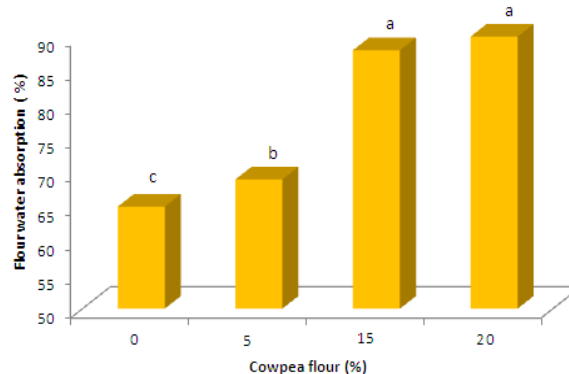


Fig. 2 Water absorption of wheat-cowpea flour composite Means not followed by the same superscript are significantly ( $P < 0.05$ ) different.

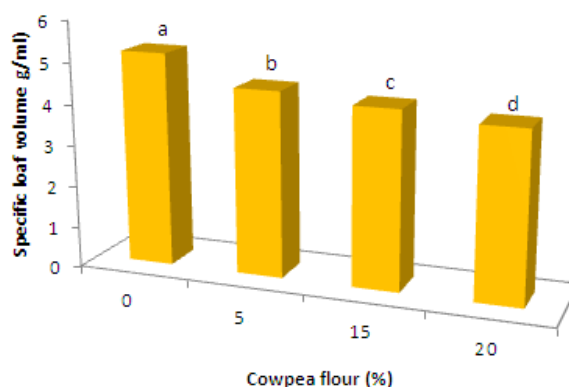


Fig. 3 Influence of cowpea flour on loaf volume Means not followed by the same superscript are significantly ( $P < 0.05$ ) different.

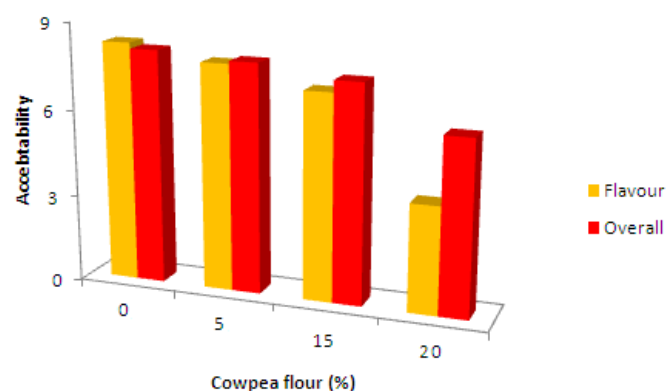


Fig. 4 Sensory evaluation of breads made with different levels of cowpea flour Means not followed by the same superscript are significantly ( $P < 0.05$ ) different.

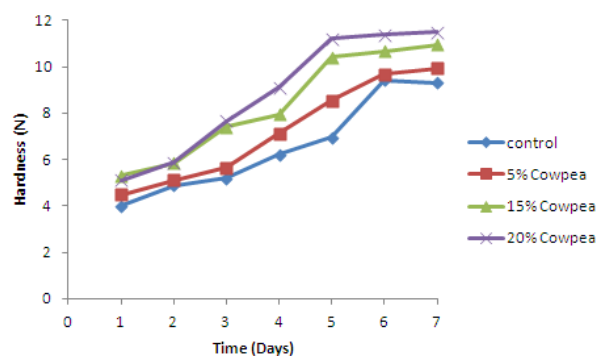


Fig. 5 Hardness of bread crumbs prepared with different levels of cowpea flour

TABLE II  
PROXIMATE COMPOSITION OF WHEAT AND COWPEA FLOUR

Flour	Components (g/100g flour)					
	Moisture	Protein	Lipid	CF <sup>1</sup>	TA <sup>2</sup>	CHO <sup>3</sup>
Wheat	13.3	9.7	1.47	0.84	0.47	74.22
Cowpea	8.1	25	1.63	4.4	3.7	57.17

<sup>1</sup>CF= Crude fibre; <sup>2</sup>TA= Total Ash; <sup>3</sup>CHO= Carbohydrate (by difference).

TABLE III  
PROXIMATE ANALYSIS OF BREAD

CF <sup>1</sup> (%)	Chemical composition of bread (g/100g sample)					
	Moisture	Protein	Lipid	CF <sup>2</sup>	TA <sup>3</sup>	CHO <sup>4</sup>
0	28.5c	6.1d	1.7a	0.08c	3.0c	58.92a
5	29.6b	7.4c	1.6a	1.4b	3.4bc	54.80b
15	31.1a	8.6b	1.3b	2.3ab	3.9ab	49.70c
20	29.9b	9.9a	0.9c	3.4a	4.9a	47.50d

<sup>1</sup>CF= Cowpea flour; <sup>2</sup>CF= Crude fibre; <sup>3</sup>TA= Total Ash; <sup>4</sup>CHO= Carbohydrate (by difference).

Means in the same column not followed by the same superscript are significantly ( $P < 0.05$ ) different.

#### IV. CONCLUSION

The protein content of wheat/cowpea composite breads ranged from 6.1 – 9.9%. Water and oil absorption capacities of the flour blends increased with increasing cowpea flour contents. The control bread samples (wheat flour only) and bread samples containing 5% cowpea flour had almost similar properties, while bread made with 20% cowpea flour give lower overall acceptability. To conclude, we can suggest that the fortification of bread with cowpea flour produced a high protein product and that can be used as protein-rich food for the relief of malnutrition in the poor countries.

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