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Development of High Protein Flour Using Cow Pea

[1]TSHALIBE R.S., [1]USAI T., [2]NYAMUNDA B.C., [1]MANHOKWE S.
[1]*Midlands State University, Department of Food Science and Nutrition, P Bag 9055, Gweru, Zimbabwe.*
[2]*Midlands State University, Department of Chemical Technology, P Bag 9055, Gweru, Zimbabwe*.

ABSTRACT: *Improvement of the nutritional quality of cereals is important in reducing malnutrition in disadvantages communities. The focus of this study was to develop a nutritionally rich wheat-cow pea flour blend. Different quantities of cow pea flour were blended with wheat flour. The flours were tested for colour, falling number, water and protein content. Sensory evaluation was carried out on the cow pea blended bread samples to evaluate quality. There was an increase in protein content of cow pea blended flour. The volume of bread increased with increasing cow pea protein. The palatability and texture of the blended bread was highly acceptable. :*

KEYWORDS : *blend, cow pea, dough, flour, protein content, wheat*

I. INTRODUCTION

Many communities in developing countries rely on wheat flour as their staple food in the preparation of bakery products. However, wheat flour has low nutritional value to overcome malnutrition and under nutrition that are prevalent in developing countries. Several methods have been employed to improve the nutritional quality of cereals such as amino acid fortification, supplementation and complementation with protein concentrated and isolates of their protein rich sources such as grain, legumes coming into practice [1].
Bright [2] indicated that food legumes are used for protein enrichment of bread and cookies. Matz [3] indicated that in cereal legume fortification provide higher protein flours. These flours lead to longer baking times because water is held more firmly by the protein. Higher protein also leads to decrease in bread tenderness [4]. The combination of cereals and legumes provides a good balance of amino acids.

Cow pea legume is a rich source of proteins that can be used to blend wheat to form wheat-cow pea flour [5, 6]. In addition to protein, vitamin A and mineral content, cow pea seed coats contain flavonoids, antioxidants that protect cells from damage caused by free radicals [7]. Wheat alone is low in lysine but high in methonine. Lysine is an essential amino acid which cannot be synthesize by the body. Lysine is required for growth [8]. Another important nutritional advantage is the complementary effect of wheat and cow pea which combines methionine and lysine. When blended with cow pea, wheat may produce high protein flour for bread making due to the complementary effect. A blend of cereals and legumes will be an added advantage since cereals such as wheat are also nutritious [9]. There is mounting evidence highlighted in recent review that low glycemic index foods can play an important role in a healthy diet [10]. Cow peas are considered to be a valuable dietary source of slowly digestible starch, a form of starch that is considered beneficial to health since it results in relatively low-post meal blood glucose level compared with more readily digested starch (important to diabetic patients). Cow peas contain phytonutrients and dietary fibre that lower cholesterol and reduce overall risk of heart diseases. Vitamin C and potassium present in wheat cow pea flour also help reduce incidences of heart disease [11]. Nutrient composition of cow peas suggests that they are a very good source of proteins, carbohydrates, thiamine, riboflavin, calcium, iron and soluble fibre [7]. Cow pea is high in protein (20-25%), about two or three times higher protein than most cereals [12]. There is evidence in literature linking cereal-legume blending and increase in overall nutrients. Asma [13], evaluated protein quality of various combinations of sorghum with cereals and legumes. In a study done by Hallen [14] wheat flour in a standard bread formulation was partially replaced with cow pea flour at different levels. Increasing levels of cow pea flour resulted in changed flour quality characteristics such as ash, protein and colour. McWatters [15] reported that the wheat bread blended with 15% cow pea exhibited a good quality that did not compromise sensory quality. In Nigeria cow pea-amala blend was produced form yam flour and cow pea flour [16]. Amala produced from these blends was not significantly different in taste and texture from the unblended yam flour.

This study focuses on developing a healthy nutritive product, wheat-cow pea flour. In Zimbabwe cow pea has not been effectively utilized in flour though cow peas are readily available and are a popular part of the traditional food system. Development of wheat-cow pea flour can be an opportunity for the appraisal of cow pea

farmers. According to Chadha [17], cow pea can be grown in any type of soil although well drained slightly heavy soils are better. It is grown in all seasons.

II. METHOD

2.1 Preparation and blending of cow wheat flours

Wheat (1 kg) cow pea (1 kg) were separately ground to fine powders (flours). After grinding the individual flours were tested for moisture content. Wheat cow pea blends of different percentage weight compositions were produced by thoroughly mixing the flours. The blends were then taken for nutrition composition.

2.2 Flour tests

2.2.1 Protein, water absorption and moisture content

Protein content, moisture content and water absorption of the cow wheat flours were determined using the near infrared refractometry analyser (spectrasta 2400). A sample of flour was put into a cuvett and placed in the near infrared refractometry (NIR) analyser. After 25 seconds the results were recorded for protein content, water absorption and moisture content. Wheat flour was used as the control sample.

2.2.2 Falling number

About 7 g of each blend of flour was thoroughly mixed with 25 ml of distilled water. The dough was transferred into a test tube and heated in a falling number machine (JJLF). The time of descent of a viscometer stirrer in gelatinised flour suspension which was more or less liquefied by the alpha-amylase was recorded as the falling number.

2.2.3 Colour

Separate flour samples were mixed with water in a test tube to form a slurry. The test tube was then put in the Kent Jones colour grader machine (Hunterlab D25-9SM) and the reflection of light from the surface of flour at 530 nm wavelength was determined.

2.2.4 Farinograph

About 300 g of each blend of flour was mixed with 67 ml of water in a Farinograph mixer bowl. Mixing and recording of measurements on the Farinogaph (Brabender MLNJ15/15A) occurred simultaneously until the dough developed to its maximum viscosity.

2.2.5 Preparation of bread

Separate doughs were made by thoroughly stirring 150 ml of water with a mixture of 250 g of flour, 5 g of salt, 5 g of sugar, 7.5 g of yeast and 2.5 g of fat. The dough was left to rise in a proof box at 30°C for 30 minutes. When the dough had approximately doubled in size it was kneaded to redistribute air pockets and ingredients and returned to the proof box for a further 15 minutes before being molded in a pan and left to rise for a further 20 minutes in a proof box. Baking was done in an oven set at 135°C.

2.3 Sensory evaluation tests

The questionnaires were distributed to a panel of ten people. Open ended questions were used to evaluate the quality of bread samples.

III. RESULTS

3.1 Flour quality

3.1.1 Protein, water absorption and moisture content

Table 1 shows the moisture capacity, protein and water content of different blends of flour. Protein content increases with increasing percentage weight composition of cow pea. Aletor [18] reported that the cow pea protein content ranged from 25.6-27.4%. Hence blending wheat with cow pea would increase the overall protein content of wheat flour. In another study cow pear-amala was produced from yam flour and cow pear flour [16]. All fortified samples showed better protein composition than the unblended yam flour.

The moisture content of flour samples decreased with increase in cow pea composition, although the change was slight. The values for moisture content fall within the generally acceptable range (8-14%) [3]. There is an increase in water absorption as the percentage cow pea content increases. According to Cauvain [19] proteins absorb their own weight in water, so that a high protein content flour naturally absorbs more water than a lower protein one [19]. This trend is in agreement with previously reported results. Sharma [20] observed that water

absorption increases significantly with increased amount of cow-pea. Cauvain [19] also found that water absorption increases with decreasing moisture content.

Table 1: Protein and water qualities of cow pea flours

Flour quality	Composition of cow pea in flour (%)			
	0	10	20	40
Protein content (%)	7.5	9.8	11.4	13.2
Moisture content (%)	11.8	11.2	10.5	10
Water absorption (%)	3.6	2.6	3.2	3.5

3.1.2 Falling Number

According to Cauvain [19], falling number is a measure of cereal alpha amylase content of flour. The effect of adding cow pea flour to wheat flour is illustrated in Fig. 1. There was a decrease in falling number upon addition of cow pea. However there was no distinct trend using different quantities of cow peas. The falling numbers of flour blends fall within acceptable range (250-350 s) of Zimbabwe flour producing companies. The trend is in agreement with previous studies done by Sharma [20] and Hallem [14]. Since cow pea is not a cereal, falling number is subject to decrease as cow pea content increases.

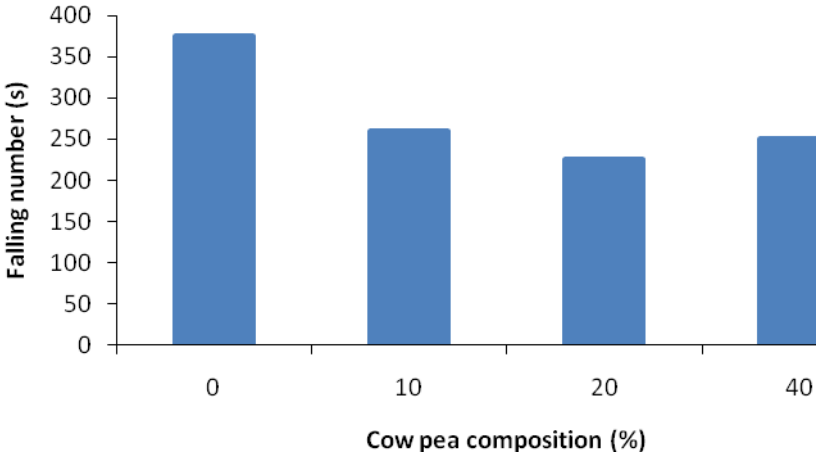

Figure 1: Falling numbers of different wheat cow pea flour blends

3.1.3 Colour

The colour of the flours darked with increasing cow pea content. These observations are in agreement with studies done by Hallem [14].

3.1.4 Farinograph

Table 2 summarises results of farinograph tests. Peak height gives the baker an idea of how much time it will take to reach maximum rising. Peak time gives an idea of how much mixing time is required [21]. Tailing time gives an idea of how much time it will take for dough to fall. The dough is most stable at maximum peak height. The dough will develop within the peak time and tailing time represents the weakening of the dough. According to the standards of local bakers, flours with peak height 3.5, peak time 4.0, tailing height 3.0 exhibit good baking qualities. From Table 2, only 0 and 10% cow pea blends are within specification hence will give good baking qualities. In a study done by Hallem [14], farinogragh characteristics were changed as a result of partial replacement of wheat flour with cow pea flour. Sharma [20] indicated that mixing tolerance and dough development time increased significantly with increased amount of cow pea.

Table 2: Farinograph results of different wheat cow pea flours

Flour quality	Composition of cow pea in flour (%)			
	0	10	20	40
Peak height	4.0	3.5	2.9	1.2
Peak time	3.8	4.3	4.5	2.8
Peak time	2.9	2.7	1.9	0.7

3.2 Physical qualities of bread

The weight of bread (Fig. 2) shows no specific trend in weight changes as a result of differences in cow pea content. The same quantities were used for bread making hence no significant weight variations.

There was a decrease in volume of bread with increase in cow pea content. Bread containing 0% cow pea had the highest volume (3000 cm^3) while bread containing 40% cow pea had the least volume (1200 cm^3). The bread became more compact with increase in cow pea content. These observations are supported an investigation done by Mcwatters [15] in which 100% wheat bran had a volume 2580 cm^3 and 30% cow pea bread had 1644 cm^3. Hallem [14] pointed out that incorporation of cow pea exerted a volume depressing effect on the bread and gave a compact structure and higher substitution.

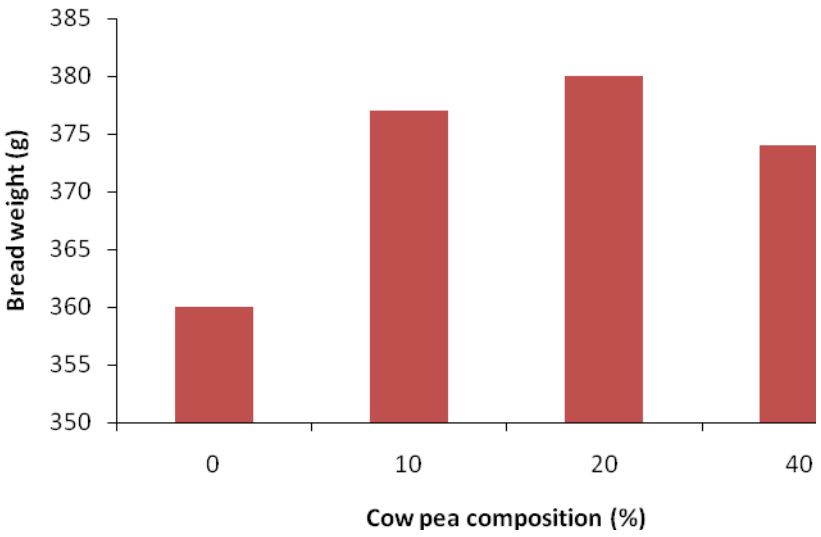

Figure 2: Weight of bread with different cow pea compositions

3.3 Sensory evaluation tests

3.3.1 Taste

Fig. 3 shows that the majority which is about 60% disliked the taste of 40% cow pea bread, the taste of 20% cow pea bread was more acceptable than that of 40% cow pea bread. The taste of 0% cow pea bread was the best with none disliking it. From the results increase in cow pea results in an unacceptable taste. In an investigation done by Ashay [16], results of sensory evaluation at 0, 10, 20 and 40% cow pea substitution showed that all blends in terms of taste were not significantly different from the control.

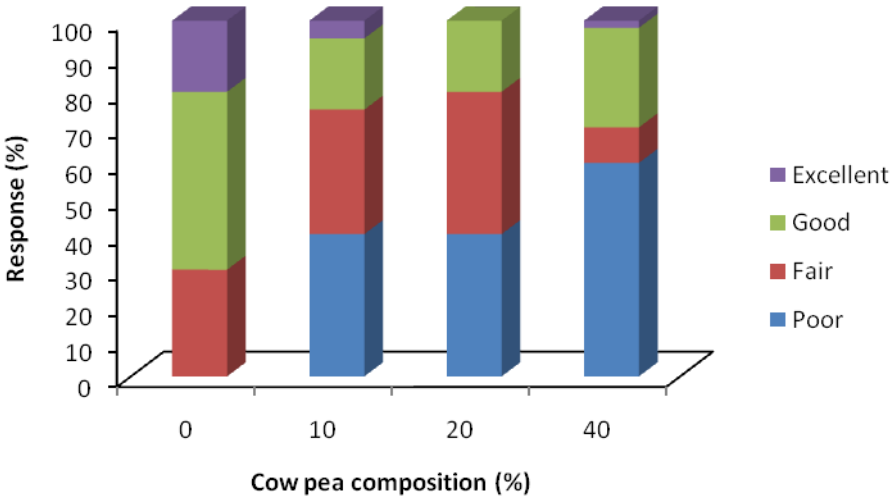

Figure 3: Responses to taste of different bread samples

3.3.2 Palatability

The palatability of cow pea bread is shown in Fig. 4. 50% of the respondents found 40% cow pea bread not palatable. The bread with 20% cow pea was palatable to 80% of the respondents. 10% cow pea bread had its

palatability preferred by 90% of the respondents while 0% cow pea bread sample was palatable to everyone. The palatability of bread baked with wheat cow pea flour has been well accepted in Columbia, Kenya, Nigeria, Senegal and Sudan [22, 23]. Philips [24] pointed out that cow pea is favoured worldwide because of its palatability.

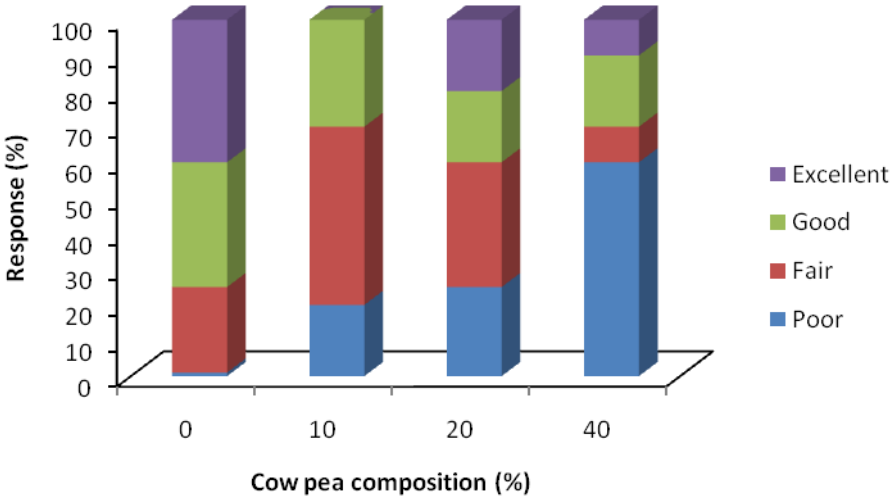

Figure 4: Responses to palatability of different bread samples

3.3.3 Colour of crust

Fig. 5 shows that 70% of the population liked the colour of 40% cow pea bread while more than 94% of the respondents were impressed with the colour of bread containing 0, 10 and 20% cow pea. From an investigation carried out by Ashay [16], ten members assessed the colour of bread containing cow pea and found that the colour of crusts was not significantly different from the bread without cow pea. The colour of crust improved with decrease in cow pea content. In an investigation done by Mcwatters [15] showed that the colour of crust of cow pea flour blends where not different ($p<0.05$) from the unblended wheat bread.

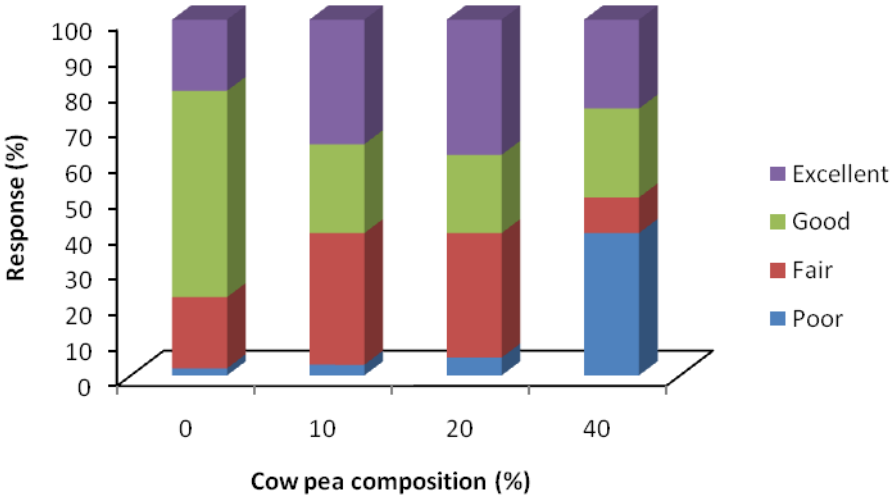

Figure 5: Responses to colour of different bread blends

3.3.4 Texture

Texture and consistency can be felt in the mouth. Crumbs of softness or firmness is the texture property which has attracted most attention in bread assessment because of its close association with human perception of freshness [19]. Fig. 6 shows texture responses to various blends of bread. More than half of the respondents disliked the texture of 40 and 60% cow pea bread. 55% of the respondents were satisfied with the texture of 10% cow pea bread. Results for 0% cow pea bread showed that the majority (90%) found the bread texture satisfactory. Sharma [20] reported that the texture of bread reduced significantly with cowpea blending.

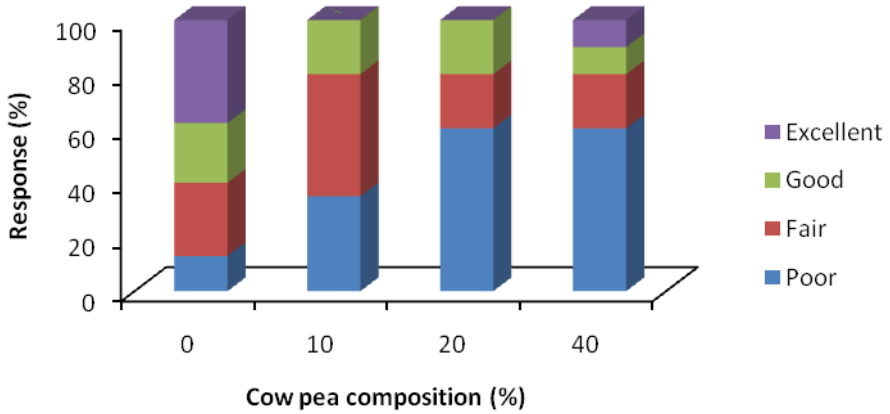

Fig 6: Responses to texture of different bread blends

IV. CONCLUSIONS

This study has shown that blending wheat flour with cow pea resulted in a healthy nutritive product. Different views were obtained from the sensory evaluation. The bread became more acceptable with decrease in cow pea content. All the bread samples were edible. Further studies to find methods of improving the bread sensory qualities need to be carried out.

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