CASSAVA IN COMPOSITE FLOURS FOR BREADMAKING

by

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1. Composite flour

The term 'Composite flour' describes a flour mixture constituted from more than one material which may or may not be indigenously produced. Wheat flour may or may not be part of the flour mixture. The end-products from the composite flour may be traditional foods or western-type products such as bread, biscuit and pasta (noodles).

2. Wheat flour

Wheat flour protein forms with water an elastic substance called gluten which gives it the unique properties suitable for breadmaking. There are five kinds of protein in wheat flour namely albumin, globulin, proteose, gliadin and glutenin. The first three of these are soluble in water and provide some of the necessary nitrogenous yeast food during fermentation and the breadmaking process. With the addition of water to wheat flour, gliadin and glutenin form gluten. (4)(7)

In the dough structure gluten retains carbon dioxide generated by the yeast in the form of small gas cells. This results in light evenly structured loaf with soft crumb as desired in leavened bread. (7) The ability of a dough to produce these desired characteristics in bread is largely determined by the quality and quantity of gluten it contains.

3. Dough Development

Various methods are used in the preparation of bread from wheat flour. (6)(13) The aim of each method is to condition or develop the gluten into such a state that its ability to expand and retain gas during fermentation and baking is optimal. To achieve this, conventional breadmaking methods generally subject the dough to long bulk fermentation time. It must be mentioned here that a combination of many factors including fermentation time result in the development of gluten. Some of these are: amount of yeast, yeast activity, amount of water in the dough, manipulation and effect of other additives. (7)

Other methods for the development of gluten structure in bread dough are the mechanical dough development— Chorleywood process in U.K., and the Activated Dough Development (ADD) (6). In the first, vigorous mixing involving expenditure of high level of mechanical work on the dough with the assistance of some oxidizing agents develops the dough into the desired structure. Oxidising agents such as potassium iodate, azodicarbonamide, ascorbic acid or potassium bromate have been found suitable for this purpose. In the mechanical dough development method, especially designed mixers called high speed mixers with very powerful motors are used. This method completely excludes the bulk fermentation stage in the breadmaking process. The dough is divided, moulded and baked immediately after mixing.

Using conventional dough mixers, balanced blends of oxidizing and reducing agents are used to effect dough development in the chemical or Activated Dough Development (ADD) method. Reducing agents such as Lacystein hydrochloride and sodium metabisulphite and such oxidizing agents as potassium bromate and ascorbic acid have been found effective in ADD method.

4. Rheological and Baking Properties

Cassava and products derived from it are deficient in gluten. Addition of these products to wheat flour, therefore, dilutes the gluten in the wheat flour with the resultant deteriorating effect on the breadmaking properties of the wheat flour.

Investigations (3)(5)(9) carried out on rheological and baking properties of flour blends containing various levels of cassava flour and cassava starch showed that

- water absorption of blends containing cassava flour increased as the percentage tuber flour was increased whilst absorptions of blends with cassava starch decreased progressively as the starch level increased.
- dough development time and stability of the dough decreased as the cassava flour level was increased.
- loaf volume of bread containing cassava starch was comparable to that of all-wheat bread up to 20 per cent level of addition.

- loaf volume of bread decreased as the level of cassava flour increased in the cassava/wheat blend.

- acceptable bread could be produced with 15 per cent of cassava starch or flour although the dough containing cassava flour was difficult to handle.

- as the percentage of cassava flour was increased the bread crust colour increased in darkness due in part to the higher sugar content in cassava flour compared with wheat flour.

- in contrast, cassava starch diluted the natural sugars in wheat flour, resulting in bread with pale crust colour.

- bread containing cassava starch had a whiter crumb colour than did all-wheat bread because the pigments which give colour to wheat flour are diluted by cassava starch.

- as the percentage cassava flour increased crumb colour increased in grayness.

- the texture of bread became dense as the level of cassava starch or flour was increased.

- regardless of procedure, blends with cassava starch showed better baking response than blends with cassava flour. Baking response of cassava flour improved and became comparable to that of cassava starch when the flour was sifted with a fine mesh (sieve 12XX). This was attributed to the low fibre content of the sifted flour.

Other workers (15) using blends of gari and wheat flour for breadmaking found that

- water absorption of flour increased as the level of gari was increased.

- dough development time decreased as the level of presoaked gari was increased.

- in contrast, dough development time increased as the level of dry gari was increased.

- bread volume decreased as the level of gari increased.

5. Level of substitution

For any wheat flour there will be a limit of tolerance to dilution with cassava starch or other material. This will depend on the quality of the flour itself, the method to be used and the quality of the cassava starch or other diluent used (5).

Strong wheat flours with good quality protein of about 15% have better tolerance to dilution with non-wheat flours compared with weak wheat flours (protein content below 10%) (5)(12).

With conventional breadmaking methods, the highest level of dilution without deterioration of bread quality is 10-15% cassava flour, starch or gari (3)(10)(15). This level of dilution can however be increased with the aid of certain dough improvers such as calcium stearyl-2-lactylate which has a marked quality - improving effect on dough characteristics and bread quality (10). Addition of this dough improver results in cassava/wheat bread with soft crumb and high volume comparable to all-wheat bread. It also retards staling which is rapid in cassava/wheat bread.

Mechanical dough development gives superior bread in respect of loaf specific volume, crumb structure and softness compared with other bread-making methods (8)(3)(14).

The table below shows a list of composite flours (with cassava starch) that have been successfully used to produce acceptable bread using the mechanical dough development method. (8)

	Parts by weight			
	1	2	3	4
Wheat flour	64	60	50	64
Cassava starch	30	30	38	30
Soya flour	6	10	12	3.5
Fish protein concentrate				2.5

6. Protein enrichment

Cassava and products derived from it contain very low levels of protein (cassava flour - 1.3%; starch 0.3%; gari 0.9%). Bread made from composite flour containing cassava may require protein enrichment. Protein flours of both plant and animal origin that may be used include soya bean flour, groundnut flour, milk solids, fish protein concentrate, flours from other legumes etc.

7. Bread without gluten

The Institute for Cereals, Flour and Bread, TNO in Wageningen in the Netherlands in collaboration with the FAO, UN, has developed a method for the production of composite flour bread in total absence of wheat or gluten (10)(11). The main ingredients used for this bread are cassava starch, maize starch, soya flour, and peanut flour in different combinations of 20% protein flour and 80% starch.

This bread without gluten is made with the aid of dough improvers such as glyceryl monostearate and calcium stearyl-2-lactylate which have the ability to bind starch particles into a cohesive structure that is able to retain gas and thus allow the dough to rise (1). It is reported that doughs obtained from these mixtures differ considerably in their consistency and cohesive properties from the conventional wheat dough. They are in the form of semi-liquid batter closely resembling a cake batter. The authors of this work remark that conventional breadmaking equipment could be used for this type of bread, though the dough is quite sticky. Conventional cake-making equipment are more suitable for this method. Products from these efforts have been termed bread-like. It is envisaged that any programme aimed at commercial production of such bread will have to be backed by an effective consumer education in order to promote its acceptance.

8. Production of Cassava/Wheat composite flour for breadmaking

8.1 Cassava Processing

A cassava processing plant needs to be located near the source of raw material supply in view of the fact that cassava tubers are highly perishable and need to be processed within 2 days after harvesting. Such a location may or may not be near an existing wheat mill.

Fresh cassava tubers are bulky with a moisture content of more than 50% compared with the dry cassava products which contain not more than 14% moisture. It would therefore be less costly to transport the products (starch, flour or gari) to the wheat mill.

8.2. Formulation of Composite Flour

Since a greater proportion of the composite flour would be made up of wheat flour, mixing of the components would be done at the wheat mill where facilities exist for mixing and for effecting quality control. The wheat mill would need to work in close co-operation with an organisation that has competent personnel to advise on formulations and use of composite flours. In a situation where the quality of wheat flour available to bakers is likely to be variable a very close supervision of composite flour formulation should be exercised. Formula for the composite flour would depend on 1. the characteristics of wheat flour (2) characteristics of cassava component and (3) facilities available to bakers for breadmaking.

There is a need to determine and draw up specifications for cassava flour, gari or starch suitable for breadmaking. This will help in no small way to ensure that quality requirements for composite flours are met.

9. Training

In order to ensure appropriate use of the composite flours a programme should be organised to train bakers. In Ghana each baker is registered and belongs to a zonal co-operative group through which inputs for breadmaking are distributed. The Zonal groups are based on the location of bakeries.

With the Ghanaian set up, zonal leaders of bakers can be trained at courses organised at the national level. Armed with the knowledge acquired, the leaders can assist the organisations training courses in respective localities, using the facilities of a member of the zonal group.

At the regional level, courses will need to be organised by FAO/ECA to train personnel who will be responsible for the training of bakers.

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