



## STARCH IN INSTANT *FUFU* GRANULES

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### Summary

The amount of free starch in a dehydrated instant *fufu* preparation determines the degree of stickiness of the reconstituted product. Cassava granules contain the highest amount of free starch and yam the lowest, and hence instant *fufu* granules made from cassava (Ankrah) produces more sticky *fufu* than *fufu* made from plantain (Apantu), yam (Labreko) granules or mixtures of these with cassava.

### Introduction

In order to reduce storage losses and cut down on transport costs, great interest has, in recent years, been shown by food scientists in Ghana and elsewhere in turning the bulky starchy staples found in Ghana and in other tropical countries into pre-cooked dehydrated powdery products which may be reconstituted with water into *fufu*, a popular, dough-like African food which these starchy crops are traditionally used in preparing. The starchy staples include yam (*Dioscorea* spp.), cassava (*Manihot esculenta* Crantz.) sweet potato (*Ipomoea batatas* Poir.), cocoyams (*Colocasia antiquorum* Schott., and *Xanthosoma sagittifolium* Schott.), and plantain (*Musa paradisiaca* Linn.).

Jarmai & Montford (1968) have described a technological process for producing pre-cooked yam flour (or granules) which may be reconstituted into *fufu*. They also mention that this method could be used to produce cassava flour. Safo (1965), working at the Food Research Institute in Canada, produced *fufu* balls by adding tapioca (cassava) flour to partially reconstituted potato flakes, a practice which many a Ghanaian living in Europe or America has often adopted to prepare his native *fufu*.

In the traditional method of preparing *fufu*, the starchy crop is peeled, cut into pieces and boiled in water until cooked. The

pieces are drained of water and pounded, using a wooden mortar and pestle, into a sticky mass which is the *fufu*. The process of preparing *fufu* is time-consuming and laborious and this fact has often been given as one of the reasons for the search for a more convenient method of preparation.

The most outstanding characteristic of *fufu* is its stickiness, which, according to Coursey (1967), is due to the breakdown of the cellular and, to some extent, the starch granular structure during the pounding process. The stickiness of *fufu* prepared in the traditional manner depends on the food material from which it is made. Of all food materials used, cassava produces the most sticky *fufu*. *Fufu* made from plantain, yam or cocoyam is less sticky than the cassava product and often needs the addition of cassava to give it the right gumminess.

In making precooked instant *fufu* granules, which would reconstitute into acceptable *fufu*, the criterion should therefore be a product which, on reconstitution, would produce a sticky mass of the right consistency. This is very much in contrast to instant mashed potato products which should be mealy when reconstituted. An instant mashed potato product which contains a high proportion of soluble or free starch on reconstitution yields a sticky, stodgy mash (Toffolo, 1968; Cross, 1969; Williamson, 1969; Harrington *et al.*, 1960).

To improve the reconstitution characteristics of dehydrated instant potato preparations, emulsifiers are usually added to them. Emulsifiers form insoluble complexes with any free starch which is present, preventing it from forming a sticky gel when the dehydrated preparation is reconstituted (Bourne *et al.*, 1960).

From work done on precooked instant potato, it may be inferred that any instant granules (powder) or flakes to be used in preparing *fufu* should contain a fair amount of free or soluble starch which may be

released during processing or added as pure starch. Instant *fufu* granules or flakes made from different starchy staples may, depending on the amount of inherent free starch released during processing, reconstitute into *fufu* of varying degrees of stickiness and consistency.

To determine the quality of the product in the precooked instant potato process, Mullins and his associates (1955) developed a colorimetric method in which the soluble starch amylose readily extracted by an excess of distilled water at 150°F (65.5%) provides a good texture index. The soluble starch extracted is estimated by photoelectric measurement of the intensity of blue colour formed by the addition of iodine to the filtered extract. In this test, known as the Blue Value Index (BVI), it is assumed that the soluble starch is more readily extracted from the extra-cellular gelled starch than from the starch gel present in the intact cells.

In the work described in this paper, the BVI has been used as a means of establishing a relationship between free starch in precooked instant *fufu* granules prepared from various starchy staples and the stickiness or texture of the reconstituted products.

### Materials and methods

The food materials used in the investigations included cassava (*Manihot esculenta* Crantz.) cultivar Ankrah, yam (*Dioscorea rotundata* Poir.) cultivar Labreko and plantain (*Musa paradisiaca* Linn.) cultivar Apantu. These were bought from a market in Accra and processed the same day. The same treatment was given to each food material. Instant potato granules and flakes supplied as samples by Bibbys, a firm of food processors in the United Kingdom, were included in the experiments for purposes of comparison.

#### Processing of instant *fufu* granules

After peeling, 25 lb of each food material was weighed and cut into slices  $\frac{1}{2}$  in thick. The pieces were put in boiling water and cooked for 15 min. They were drained,

allowed to cool to about 80 °C and mashed in a Kenwood mixer A for 2 min at speed 1. The mash was dried to 8% moisture content in an Apex Tray drier at 65 °C. The dried mash was ground in a beater mill and sieved in a Simon shaker sieve with meshes of 10xx (129  $\mu$  aperture), 11xx (117  $\mu$  aperture) and 12xx (112  $\mu$  aperture). The fractions collecting over the meshes and those passing through 12xx mesh were collected separately and sealed in polythene bags.

Three main series of granule preparations were made. Each series consisted of 3 batches of granules prepared separately from yam, cassava and plantain. From the 2nd and 3rd series of preparations, mixtures of plantain-cassava and yam-cassava granules in the proportion of 2 plantain or yam and 1 cassava were prepared by mixing fractions passing through 12xx mesh in a Forster roto-mixer.

For the determination of BVI and texture, granule preparations passing through 12xx mesh were used as it had been found in previous experiments that this granule size produced the smoothest and best reconstituted *fufu* when the reconstitution was done in a Kenwood mixer.

#### Determination of Blue Value Index

500 ml of distilled water heated to 180°F (82.2°C) was quickly measured into a 600 ml beaker. The hot water was stirred with a magnetic stirrer at a moderate rate until the temperature fell to 150°F (65.5°C) when 2.5 g of a sample of granules was quickly added and the stirring continued for a further 5 min. The stirring was stopped and after 1 min, 100 ml of the suspension was filtered through folded filter paper.

A 5 ml portion of the filtrate was transferred into a 250 ml conical flask containing 1 ml of 0.02 N  $KI_2$  solution. 44 ml of distilled water was added. A blank solution containing 1 ml of 0.02 N  $KI_2$  and 49 ml of distilled water was also prepared and used in each test.

The blue colour intensity was determined with the Coleman photoelectric colorimeter fitted with 655 red filter having a trans-

*Blue Value Index and texture of instant fufu or potato preparations*

Type of instant fufu or potato preparation	1st series of preparations		2nd series of preparations		3rd series of preparations	
	BVI	Mean texture score	BVI	Mean texture score	BVI	Mean texture score
<i>Granules</i>						
Cassava .. .. .	135	5.8	145	5.5	150	5.8
Plantain .. .. .	67	3.6	73	3.5	69	3.8
Yam .. .. .	53	2.5	43	2.2	57	2.7
Plantain-cassava mixture			89	4.3	92	4.7
Yam-cassava mixture ..			85	3.5	86	4.2
Bibbys potato granules ..			17	1.0	17	1.0
<i>Flakes</i>						
Bibbys potato flakes ..			19	1.4	19	1.0

mission range of 640-700  $m\mu$ . The instrument was set to zero with the blank solution in the colorimeter test tube. The blank was then replaced with the blue solution containing the extract after the tube had been rinsed with the latter, and the scale read. The reading multiplied by 100 is the BVI.

BVI determinations were carried out in duplicate on all pure granules of yam, cassava and plantain and on the granule mixtures of yam-cassava and plantain-cassava. The mean of the two readings was taken as the BVI for a preparation. BVI determinations were also carried out on Bibbys instant mashed potato flakes and granules.

#### *Determination of the texture of reconstituted granules and flakes*

To determine the texture of reconstituted granules or flakes, 100 g of the preparation was weighed and put in a Kenwood mixer A. 200 ml of boiling water was added to it and mixed at a speed of 4 for 3 min. The reconstituted *fufu* or mashed potato was removed from the mixer and moulded in a plate into a ball with the hand. For texture evaluation, pieces of the samples to be

evaluated were presented on a plate to each member of a taste panel.

Three texture evaluation tests were carried out, one for each series of batch preparations of granules. In the first test, samples of *fufu* reconstituted from pure granules of yam, cassava, and plantain made in the first series of preparations were evaluated for stickiness by a panel of six members using a scoring scale in which a score of 6 denoted an extremely sticky texture and a score of 1 represented a non-sticky or mealy texture.

In the 2nd and 3rd tests, samples of instant *fufu* granules made in the 2nd and 3rd series of batch preparations, together with samples of corresponding mixtures of yam-cassava and plantain-cassava granules, were reconstituted and evaluated for stickiness by the same taste panelists using the same method of scoring. For comparison, samples of reconstituted Bibbys potato granules and flakes were included in these tests.

#### **Results and discussion**

The results show that the amount of free starch in an instant *fufu* granule preparation affects the degree of stickiness of the product reconstituted from it. In each series of preparations, cassava granules had

the highest BVI and the highest score for texture or stickiness. Granules of plantain and yam had low Blue Value Indices and low texture scores. The plantain granule preparations, however, always showed Blue Value Indices higher than those of yam granules and were also more sticky than yam granules when reconstituted.

The addition of cassava granules to plantain or yam granules produced mixtures with Blue Value Indices and texture scores higher than those of the pure granules of plantain or yam, the greater increase in texture and BVI appearing to take place with the addition of cassava to yam.

The Blue Value Indices of pure granule preparations of cassava ranged from 135 to 150, those of plantain from 67 to 73 and those of yam from 43 to 57. Plantain-cassava and yam-cassava mixtures had Blue Value Indices ranging from 89 to 92 and 85 to 86 respectively. These results would tend to indicate that far more free or soluble starch is produced during the preparation of cassava granules than during the preparation of either yam or plantain granules. The very high amounts of free starch in cassava preparations must account for the extreme stickiness of the cassava preparations.

Bibbys potato flakes and granules showed, on comparison with the *fufu* preparations, the lowest Blue Value Indices and texture scores. Both of these preparations contained emulsifying agents (not named) which are known to complex readily with soluble starch, reduce the obtainable BVI and produce low texture scores (Bourne *et al.*, 1960; Reeve, 1963; Toffolo, 1968). With little amount of free starch present or available in them, the potato preparations therefore produced the floury or mealy textures expected of such products.

### Conclusion

The amount of free starch in a dehydrated instant *fufu* preparation determines the degree of stickiness of the reconstituted product. Cassava granules contain the highest amount of free starch and yam the

lowest and hence instant *fufu* granules made from cassava (Ankrah) produces more sticky *fufu* than *fufu* made from plantain (Apantu), yam (Labreko) or mixtures of these with cassava. The addition of cassava granules to either yam or plantain granules increases the amount of free starch and therefore the stickiness of the reconstituted products.

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