Dehydration and Rehydration of Fufu

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ABSTRACT
The study is aimed at determining if cassava fufu can be dehydrated and to measure the rate of dehydration; subsequently the dried product would be dehydrated to establish whether it will return to the original fufu properties. The experiment were performed in order to obtain the rate of dehydration and rehydration using the lick’s second law of diffusion between each time interval, during the experiment, three fufu samples was used in the experiment i.e. normal cooked, half cooked and over cooked fufu.

The plots of dehydration and rehydration rate with moisture content, moisture content with time and their rates with time, were made for each sample showing the characteristics of fufu.

It was observed that sample 1 has first falling rate period of 0.36 – 0.12, second falling rate period of 0.12 – 0.03 at moisture content of 11.20% - 39.41% and the dehydration rate of 0.02 -0.98, sample 2 has first falling rate period of 0.32 – 0.23, second falling rate period of 0.11 – 0.06, second falling rate period of 0.06 – 0.01 at moisture content falling rate period of 34.29% - 31.67% and rehydration rate of 0.03 – 1.69 at moisture content of 28.32% - 48.75%. This will help in knowing the determination, nutritive value and shelf life of fufu.

Keywords: fufu, dehydration, rehydration.

INTRODUCTION
Fufu is a fermented wet paste made from cassava that is widely consumed in Eastern and South-western Nigeria and other parts of West African such as Sierra Leone (Blanshard et al., 1994). It is ranked next to garri as an indigenous food of most Nigerians in the south. In Nigeria, it has commercial potential that has been reported to be increasing (Nweke and Bokanga, 1994), in West Africa; fufu is usually made from yams, sometimes combined plantains, in central Africa, fufu is often made from cassava tubers like Batonde manioc. The rural and urban demand for garri is higher than that of fufu. Garri is the preferred product for higher income consumers because of the ease with which it is prepared for consumption.

Several products are processed in Nigeria, in recent years consumer preferences for the various products have shown to be dynamic. Though the 1960s and early 1970s, cassava was consumed in the following forms: 15% as fresh roots; 5% as garri; 60% as fufu; 10% as starch; and 10% as flour (Abiagon, 1971). By the early 1980s, the consumption of fufu had declined to 14% of all cassava eaten, whilst consumption of garri rose to 65% according to a natural consumption survey by the federal office of statistic (Fos, 1981). Cassava tubers, when harvested, contain a high moisture content and when fufu is produced from it, it also contain little moisture content; this moisture has to be removed in processing to fufu flour or before preservation can be adequately ensured.

It is considered that the consumer preference for fufu has reduced due to its inherent undesirable characteristics of poor odour, short shelf life and tedious preparation (Okpokiri, 1985). Its preparation involves efficient dehydration of pre-cooked cassava (manihot esculenta crantz) and cocoyam (xanthosoma maffiafa) or plantain (musa) or yam (Dioscora Spp.) followed by milling and mixing with small proportion of cassava starch to improve the binding of the fufu flour when reconstituted. Pounded fufu is traditionally prepared by pounding boiled cassava roots together with cocoyam/plantain/yam pieces in a wooden mortar using a pestle into a thick paste. It is therefore associated with lots of drudgery. Fufu flour as a convenient staple is increasingly becoming very popular in West Africa (Johnson et al., 2006).

Dehydration is the removal of moisture or water vapour from a food substance by means of thermal energy relative term and other bone – drying moisture content from an initial value to an acceptable final value (Hul, 1992). Dehydration lowers the moisture content which inhibits the growth of decay-causing organism. Dehydration also has
the advantage of reducing the weight of foodstuff to about 1/5 of the original while dehydration increases the moisture content which helps in the growth of decay-causing organisms.

MATERIALS AND METHOD

In this experiment fresh cassava tubers were harvested, peeled, washed and soaked in a bucket with 1,000ml of water to allow fermentation take place and a thermometer was inserted to note the temperature of the fermentation. The freshly fermented cassava put into a mortar, pound and rolled into balls. A pot containing 50ml of water was allowed to boil for 10 minutes before putting the fufu balls. A thermometer was inserted to note the temperature and time interval was also noted with the help of stopwatch. The water and fufu was allowed to boil at different time intervals to obtain the three samples used in this experiment at a temperature of 50°C the half done was removed, at 70°C the normal was removed and at 100°C and then the overcooked was removed and pound. The prepared samples, i.e. the normal cooked fufu, half cooked fufu and over-cooked fufu were used for experiment with a weight of 20g for each sample which was measured with a beam balance.

Dehydration Method

The laboratory batch dryer used comprises of a wind tunnel, in the form of a circular duct of diameter 1.60cm and 13.5cm long. The sample to be dried is suspended in the centre of the duct via the open end. A window is provided at the front for the observation of the solid sample to be dried. The air is heated by an 8kw heater and the centrifugal fan connected to the inlet side of the tunnel provided airflow, while the airflow rate is controlled by danger which can be measured with an electronic anemometer. By means of thermocouples the dry and wet bulb temperature is measured which is located in the duct and connected to a digital milli-voltmeter. A bottle, containing distilled water wets the wet bulb temperature measuring thermocouples via a cotton wick.

A constant air velocity was used in the drying runs in order to eliminate external resistance to the moisture loss. The inlet air dry bulb temperature was regulated (0.8°C) by a thermostat and relay which control the heaters. A measured height of 20g of fufu sample was used for each during experiment, the progress of which was followed by weighing the sample periodically in a precision balance (+0.01). For this purpose, the drying plate was removed, rapidly weighted and placed in the drier at regular intervals. The experiment is stopped when there is no more appreciable change in the weight of the sample with time. The sample is placed in a furnace maintained at about 128°C for 2 hours to determine the bone dry weight Mbd.

Rehydration Method

The bone-dried height of each sample was used for each rehydration experiment. A single unit electric cooker of 1000kw and a medium size cooking pot containing some quantity of water and suspended sticks placed on the edges of the pot were used.

The electric cooker was maintained at a constant temperature in order to eliminate external resistance to moisture gain. The water is heated for 2 minutes, before the sample plates with the samples were placed inside the pot. As the water boils it generates vapour which passes through the samples. The samples absorbed moisture as vapour.

It was necessary to add water at internal since much water is not needed in the experiment. Thus, preventing the samples from absorbing moisture directly from the boiling water.

As the water boils, the plates are periodically removed at every 10 minutes interval, noted with a stopwatch and weighted on a precision balance (+0.001) to obtain the new height. A thermometer was also used to note the initial temperature of 27°C and a final temperature of 43°C after attaining equilibrium. The equilibrium was reached when there is no more appreciable change in weight of fufu samples. The moisture content at equilibrium was obtained and this was used as the uniform moisture content of the fufu in the rehydration runs.

The experiment is stopped when there is no more appreciable change in the weight of the sample with time.

RESULTS AND DISCUSSION

Experimental data expressing moisture content (%) in terms of elapsed time (minutes) were obtained for the three sample runs of the experiment.

Figure 4.3, 4.6 and 4.9 gave a poor fit probably due to the low airflows. This means that there is an external resistance to moisture movement at such airflow rate. Although this consumption is stated by crank (1975) that the mechanism of moisture movement during drying is diffusion. This made it simple to find the different mechanism
predominant at different time during the drying runs and rehydration runs. Its accuracy in predicting drying kinetics for fufu sample has been encouraged. However, this accuracy depends on the warming up phase, flow configuration air, as well as the method of determining the weight loss data among others. It can been seen that airflow in the entire surface of the drying fufu are not uniform which led to non uniformity of convective heat and mass transfers. However, the results obtained could be compared with the improve method of electronic analytical balance which weighs continuously in a controlled air stream. The warming up phase at beginning of drying and rehydrating is most significant for drying of low moisture content samples, due to reduce initial rate and this explains the power fit for the drying rates against moisture content.

Fig. 4.0: Dehydration of normal cooked fufu with warming up period of 48.5% - 33.55% moisture content at time (0-10) minutes and decreases with increase in time (0-12) minutes.

Fig. 4.1: Rate of dehydration of normal cooked fufu with constant rate period of (0.98 -0.18) at time (10-20) minutes and falling rate period of (0.18-0.03) at time interval (30-100) minutes.

Fig. 4.2: Rate of dehydration of normal cooked fufu with constant rate period of 33.55% -28.97%, constant rate (0.36-0.12), first falling rate period of (0.36-0.12), second falling rate period of (0.12-0.03) at time.

Fig. 4.3: Dehydration of half cooked fufu with warming up period of 49.50% -43.58% moisture content at time (0-10) minutes and decreases with increase in time interval (0-120) minutes.
Fig. 4.4: Rate of dehydration of half cooked fufu with constant rate period of (0.48-0.25) at time (10-20) minutes and falling rate period of (0.232-0.03) at time interval (20-90 minutes).

Fig. 4.5: Rate of dehydration of half cooked fufu with warming up period of (49.50% -43.58%), constant rate period of (0.48-0.32) first falling period of (0.32-0.23), second falling rate period of (0.23-0.03) at time interval (0-20) minute.

Fig. 4.6: Dehydration of over cooked fufu with warming up period of 48.75%-37.12% moisture content at time (0-10) minutes and decreases with increase I time interval (0-120) minutes.

Fig. 4.7: Rate of dehydration of over cooked fufu with constant rate period (0.40-0.37) at time (10-20) minutes and falling rate period of (0.14-0.01 at time interval (30-100) minutes.
Fig. 4.8: Rate of dehydration of over cooked fufu with warming up period of (48.75%-44.59%), constant rate period (0.40-0.14), first falling rate period of (0.11-0.06), second falling rate period of (0.06-0.010 at time interval (0-120) minutes.

Fig. 4.9: Rehydration of normal cooked fufu with initial increase in moisture content of 11.20% and it increases linearly with increase in time interval (0-120) minutes.

Fig. 4.10: Rehydration of normal cooked fufu with initial rehydration Rate of 0.98 and it decreases with constant rate period of (0.40 -0.07) at time (30-90) minutes.

Fig. 4.11: Rehydration of normal cooked fufu with increase in moisture content of (11.20-39.41)% at the rate of (0.02-0.98) and constant rate period of (0.98-0.34).
Fig. 12: Rehydration of half cooked fufu with initial increase in moisture rate content of 30.105 and it increase linearly with increase in time (0-120) minutes.

Fig. 13: Rehydration of half cooked fufu with initial rehydration rate of 1.88 and it decreases with constant rate period of (0.58-0.01) at time (20-90) minutes.

Fig. 14: Rehydration of half cooked fufu with increase in moisture content of (30.10-49.50%) at the rate of (0.01-1.98) and constant rate period of (1.88-0.58).

Fig. 15: Rehydration of over cooked fufu with initial increase in moisture content of 28.32% and it increase linearly with increase in time interval from 0-1200 minutes (1.88-0.58).
CONCLUSION

From the plot of dehydration and rehydration rate against moisture content, one can see that the dehydration and rehydration characteristics show that the dehydration of fufu has little constant rate periods and two stages in falling rate period. Also rehydration of fufu shows that it has little constant rate periods because of shrinkage during drying and two stages in rising up rate periods.

Also, it can be observed that dehydration and rehydration of fufu samples increases and decreases as the temperature increases at the sample given velocity. Therefore the knowledge of the rate of dehydration and rate of rehydration in this study can be used in the design of dryer that will minimize the deterioration in the eating quality and nutritive value of fufu in order to extend its shelf life.

REFERENCE


