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Effect of emulsifiers on sensory acceptability of cassava flakes

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Abstract. Reconstituted cassava flakes mash becomes sticky, so emulsifiers are normally added to improve their textural characteristics and sensory quality. Three types of emulsifiers were added to cassava flakes: glyceryl monostearate (monoglyceride), sodium caseinate and skim milk. Sensory scores from 12 judges showed that, the use of glyceryl monostearate (monoglyceride) significantly reduced the stickiness and resulted in a whiter mash. Cassava flakes mash with sodium caseinate and skim milk powder were sticky and dark in colour reducing their sensory acceptability. Pasting characteristics of cassava flour and flakes by the Brabender amylograph indicated that, samples with glyceryl monostearate had low viscosity. This is due to the ability of glyceryl monostearate to reduce starch granules gelatinisation. Starch granules from flakes with sodium caseinate and skim milk powder, gelatinised and burst completely, which resulted into a sticky reconstituted mash. Reconstituted cassava flakes mash with glyceryl monostearate (monoglyceride) was mealy, thus acceptable like freshly cooked cassava mash.

Introduction

Cassava is a high moisture content and bulky crop. The lack of suitable preservation methods makes it very difficult to insure its supply throughout the year (Onayemi and Potter, 1974).

Cassava flakes may provide a convenience food, become a substitute for fresh cassava and stay longer. Walker (1985) defined convenience foods as those products, in a preserved state, whether frozen, dehydrated or canned, which their preparation by the customer, require minimal skills and time to produce an acceptable dietary item.

The idea of production of cassava flakes came from the available substantial information on the production of potato flakes (Wang *et al*., 1992) and sweetpotato flakes (*Ipomoea batatas*) (Walter and Purcell, 1978). Flakes are a form of dehydrated mash of a particular food. They rehydrate instantly to produce the mash with almost the same textural characteristics or "feel in the mouth" as the mash prepared from the fresly cooked food. Flakes preparation from roots involve, peeling, slicing, pre-cooking, cooking, mashing followed by drying (van Arsdel *et al.*, 1973).

To improve textural characteristics of reconstituted flakes mash, emulsifiers are added. In food products rich in starch, the effect of emulsifiers like saturated monoglycerides is often attributed to their ability to form insoluble complexes with amylose (Hoover and Hadziyev, (1981 b). Proteins are also used as emulsifiers and stabilisers. This is due to their ability to interact with water, small ions and other polymers at the oil/water interface. In that case, compounds like sodium caseinate and skim milk powder are very effective emulsifiers, stabilisers and foaming agents.

Materials and Methods

Cassava flakes were prepared with some emulsifiers to evaluate their effect on sensory quality of reconstituted mash. Roots were pre-cooked at 100°C for 5 minutes with addition of emulsifiers during the mashing process. Cassava mash was dried on a drum drier at the speed of 11.5 r.p.m (4.0 second) and steam pressure 275.8 kNm^{-2} (140°C).

Types of emulsifiers used were, stearate monoglyceride, skim milk powder and sodium caseinate. About 2% of the mash's weight of the emulsifiers was used except for stearate monoglyceride where 1.5% was used. The choice of emulsifiers was based on preliminary trials.

Cassava flakes samples were reconstituted with water (1:2). Cooked fresh cassava was used as the reference (standard). Samples were analysed by a sensory panel of 12 judges and the tests were repeated three times. The parameters evaluated were taste colour, stickiness, texture, and general acceptability. Qualitative Descriptive Analysis (QDA), which shows the kind or magnitude of differences between samples was used. A five Point Hedonic scale was used (1= extremely brown, 5 = extremely white) to characterise the different mashes.

Pasting characteristics of cassava flour and flakes. The Pasting properties of cassava flour and flakes with emulsifiers were determined using a Brabender amylograph (Brabender OHG, Duisburg, W. Germany). Cassava flour was prepared from cassava dried slices. The slices (½ x 2 x 6cm) were dried in an air draft assisted oven at 50°C for 72 hours, ground into fine flour using a coffee grinder and sieved using 710µm sieve. A buffer solution was prepared from 14.8g anhydrous disodium phosphate and 10.3g citric acid monohydrate made up to 1 litter with water. The amylograph was fitted with the 700cm. cartridge, 40g of cassava flour and flakes were weighed into 500ml beaker, then 46ml of the buffer solution and 360 ml of water were added to the flour. The mixture was stirred with a plastic stirrer and the slurry poured into the amylograph bowl. The remaining content of the beaker was rinsed with further 100 ml of water into the amylograph bowl. The amylograph was set to run with temperature change of 1.5°C/min. Samples were heated from 25°C to 95°C (AACC, 1995).

Structure of cassava starch by microscopic method. The structure of starch in ungelatinised and gelatinised cassava flour and flakes suspensions (1%) with different emulsifiers were observed using the light microscope under phase contrast and polarised light (Olympus BH-2, Japan). The eye piece specifications were 3.3LNx 10. The type of film was 150 Konica colour print film.

Results and Discussion

Table 1 shows the sensory scores of reconstituted cassava flakes mash for taste, colour, stickiness, texture and general acceptability. It was observed that, samples with stearate monoglycerides tasted better that samples without emulsifiers and those with sodium caseinate and skim milk powder. Scores for colour showed that samples with stearate monoglyceride were even whiter than the mash from fresh cassava ($P \leq 0.05$) (Table 1 and Figure 1). Samples without emulsifiers were less white compared to the mash of fresh cassava. ($P \leq 0.01$). Samples with skim milk powder were slightly darker, while those with sodium caseinate were even more darker. The probable reason of this colour change is non-enzymic browning between sugars and amino acids in casein and skim milk powder during drum drying.

Scores for stickiness showed that the mean scores for samples with stearate monoglyceride were not significantly different from fresh cassava (≤ 0.01). The results showed that samples with skim milk powder and sodium caseinate were not significantly different from each other ($P \leq 0.01$), but were more sticky than the ones without emulsifiers.

Table 1: Mean scores for sensor y evaluation of reconstituted cassava flakes with different emulsifiers.

Sample	Taste	Colour	Stickiness	Texture	General acceptability
Fresh cassava	4.70±1.31	4.00±1.55	0.50±0.33	4.0±1.20	4.60±1.56
No emulsifier	3.00±1.54	3.20±1.49	3.42±1.44	2.41±1.11	1.99±0.64
Sodium caseinate	2.70±1.09	2.24±1.38	4.85±1.26	1.70±1.16	2.32±1.81
Skim milk powder	2.51±1.46	2.86±1.47	4.70±1.31	1.83±1.19	2.48±1.87
Monoglyceride	4.10±1.37	4.40±1.28	1.22±0.88	3.90±1.24	4.31±1.75

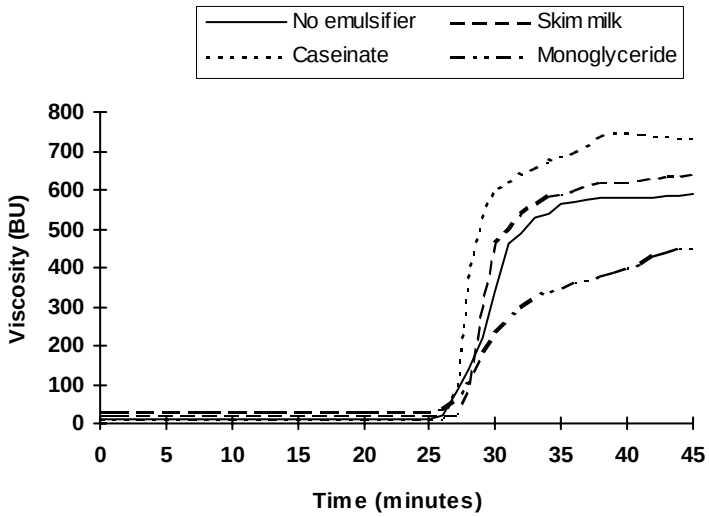

Figure 1: Effect of emulsifiers on pasting characteristics of cassava flour by the Brabender amylograph.

The texture of samples with stearate monoglycerides was not significantly different from fresh cassava sample ($P \leq 0.05$).

General acceptability of reconstituted cassava flakes mash samples with stearate monoglyceride was high approaching the scores for fresh cassava.

Pasting characteristics of cassava flour and flakes. Starch viscosity increases with gelatinisation, which is caused by swelling of starch granules. The high percentage of soluble amylose in starch may be responsible for the high viscosity values (Galvez and Resurrection, 1993).

Figure 2 show the results of the tests of the pasting characteristics of cassava flour determined using the Brabender amylograph. Samples with stearate monoglyceride had lower viscosity ($P \leq 0.01$). This suggests that stearate monoglyceride has reduced the soluble amylose which is responsible for high viscosity by forming starch monoglyceride complex. Emulsifiers did not have an effect on the pasting temperature. It ranged between 63.5°C - 65°C.

These results agree with those obtained by Hoover and Hadziyev (1982), when they found that monoglyceride reduced swelling power and amylose solubility in potato. Eliason (1985) reported that formation of complexes prevent amylose leaching during gelatinisation, inhibit excessive shelling of starch granules when heated in water and reduced water binding capacity of starch. Narravo *et al.* (1995) also mentioned that monoglyceride reduces swelling and rupture of starch granules.

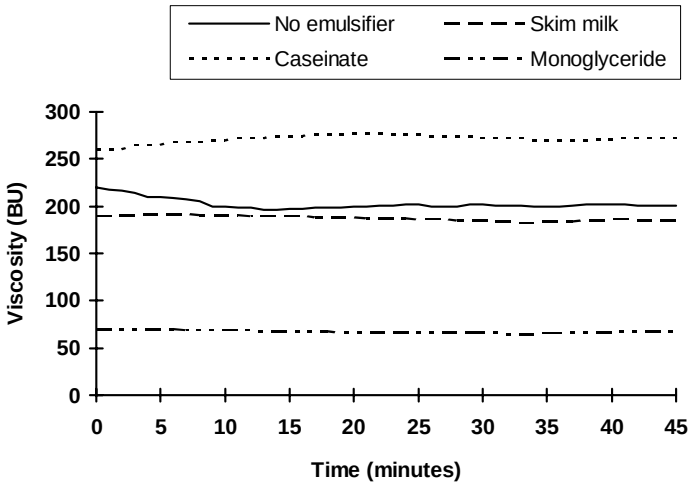

Figure 2: Effect of emulsifiers on pasting characteristics of cassava flakes by the Brabender amylograph.

The Brabender amylograph also showed that cassava flakes with stearate monoglyceride had lower viscosity ($P \leq 0.001$) compared to the flakes without an emulsifiers and those with skim milk powder and sodium caseinate. There was no peak viscosity shown because the starch in the flakes was gelatinised already. Hoover and Hadziyev (1981a) reported that addition of monoglycerides in production of mashed potato is aimed at binding free amylose to control stickiness and glueyness of the product so in this case also, stearate monoglyceride bound the free amylose in cassava flakes.

Structure of gelatinised and ungelatinised starch granules. The structures of raw and gelatinised starch granules and cassava flakes with different emulsifiers were observed using a light microscope. They were observed under phase contrast and polarised light.

In samples without emulsifiers, starch granules were found to be clumped together while in samples with emulsifiers the starch granules were dispersed in water.

Raw cassava starch (10ml, 1%) with different emulsifier was heated (with continuous stirring) on a Bunsen burner for 1 minute. Starch granules disintegrated completely and the suspension was clear (translucent). All starch granules in samples without an emulsifier and those with skim milk powder and sodium caseinate gelatinised and disintegrated completely while samples with stearate monoglyceride did not disintegrate completely.

The polarised light micrographs showed complete gelatinisation for samples without emulsifier and those with skim milk powder and sodium caseinate. Under phase contrast they showed some big particles, which may be due to aggregation of gelatinised starch granules. In samples with stearate monoglyceride, starch granules did not disintegrate completely.

Conclusion

Addition of stearate monoglyceride reduces stickiness, and makes the reconstituted cassava flakes mash acceptable. The colour of cassava flakes with stearate monoglyceride becomes whiter which even makes the product more attractive.

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