SASHA
Sweetpotato Action for Security and Health in Africa

Achieving affordable shelf-storable purée without refrigeration in sub-Saharan Africa

AUG 2017

We have succeeded in developing a vacuum-packed orange-fleshed sweetpotato purée using locally available safe preservatives that can store for three months at temperatures below 25°C. With adjustments to the recipe, high quality OFSP bread can be made. Storable purée can assure year-round availability of OFSP purée to bakers.

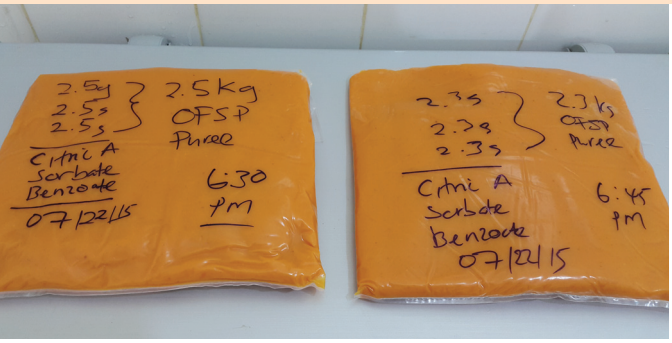

Fig. 1 Testing of different levels of preservatives for extending purée shelf-life (credit T. Muzhingi)

What is the problem?

There has been significant progress on the adoption of orange-fleshed sweetpotato (OFSP) purée (steamed and mashed roots) for bakery applications in Sub Saharan Africa (SSA). The adoption of OFSP purée as a partial wheat flour substitute has huge advantages for small-holder farmers (especially women and youth), small-scale food processors, large-scale bakeries, urban consumers and the country's economy. Small-holder farmers have income opportunities from the sale of surplus OFSP. Small-scale food processors gain business processing OFSP purée for bakeries. Bakeries in turn reduce the use of wheat flour which is quite expensive. There is a whole new market of urban consumers looking for nutritious, healthier breads, giving bakers adopting OFSP purée a competitive advantage. Governments can gain from reduced wheat imports.

Currently the major bottleneck to expanding use of purée are 1) the seasonality of OFSP fresh roots in many countries, especially in southern Africa and 2) the inconvenience of having to prepare and store the purée. Currently, OFSP purée is processed and utilized immediately for making bread in Mozambique by smaller independent bakeries and by a large biscuit maker in Rwanda. In Kenya, an independent purée processor freezes the purée at -20°C, and the frozen purée is shipped about 400 km to bakeries in Nairobi city. OFSP purée is a perishable product that must be used immediately or otherwise frozen to avoid spoilage. Therefore, processors store and utilize the roots for purée as needed, or prepare the purée and freeze it for future use. The use of cold chain is expensive in SSA. However, the technology exists to make shelf-stable OFSP purée (Fig 1). In the USA, there are high-end continuous flow microwave systems with aseptic packaging and hot-filling systems. These technologies are expensive and technologically advanced for many small-scale operations in SSA. The challenge then was to explore, investigate, test and apply the use of affordable, safe, and locally available chemical preservatives with vacuum packing, to store purée without refrigeration.

What do we want to achieve?

The goal was to develop a cost effective, shelf-stable OFSP purée that has a shelf-life of 3-6 months without refrigeration. To be cost-effective, the unit price of the OFSP purée must be lower than the price per kilogram of wheat flour. The shelf-stable OFSP purée should make bakery products that are similar to those made from fresh OFSP purée (Fig. 2).

Where and with whom are we working?

We backstop the factory Organi Ltd in Kenya on the manufacture of OFSP purée. We collaborate with Euro-ingredients Ltd on the equipment for storable purée manufacture and product development using purée. We consult North Carolina State University and Natural Resources Institute (UK) on food safety and advanced processing technologies.

How are making it happen?

Experiments were designed and conducted (Fig. 3) to test the effectiveness of chemical

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SUSTAIN
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Reaching 10 million African households by 2020

Partners

- North Carolina State University (NCSU),
- Natural Resources Institute (NRI),
- Euro-Ingredients Limited (UEL),
- Organi Limited, and
- University of Nairobi (UoN).

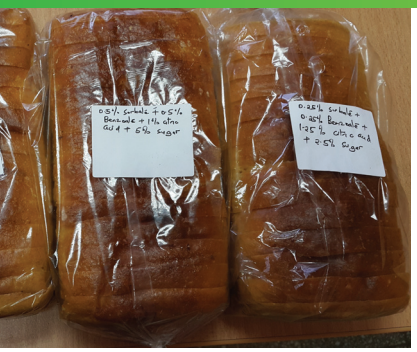

Fig. 2 OFSP bread from shelf stable purée (credit T. Muzhingi)

Fig. 3 Bread dough proofing (credit T. Muzhingi)

Fig 4 Testing bread making with shelf stable purée (credit T. Muzhingi)

preservatives together with vacuum packing on the shelf stability of OFSP purée and the effect on microbial growth, provitamin A carotenoid contents, color, smell and pH at ambient temperatures in Homa Bay county (at Organi Ltd) and Nairobi, Kenya. Different dosages of the chemical preservatives were tested for effectiveness and their effects on the sensory profiles of the final products. The chemical preservatives tested were sodium benzoate (antibacterial), potassium sorbate (antifungal) and citric acid (acidification). The first experiments tested sodium benzoate (SB), potassium sorbate (PS) and citric acid (CA) at 1% each. The second experiments tested SB 0.5%, PS 0.5% and CA 1%), the third, the fourth experiments tested SB 0.25%, PS 0.25% and CA 1% and final SB 0.1%, PS 0.1% and CA 1%.

What have we achieved so far?

All the preservative combinations tested extended the shelf-life of OFSP purée by at least three months when used together with vacuum packing and stored at temperatures below 25°C. The shelf-stable OFSP purée made bakery products that were not very different from the fresh OFSP purée. Moreover, the shelf-stable OFSP purée retained more than 60% of the provitamin A carotenoids over six months. However, there were differences on the sensory evaluation of products made with those different preservative combinations and their effects on the baking process. At high concentrations, potassium sorbate affects the effectiveness of the yeast during the dough proofing process thus affecting the bread volume (Fig. 4). At 1% concentration, citric acid reduces the pH of the purée to 4.2. However, at this concentration the final product has a sour after-taste. Then next experiments involved adjusting the OFSP purée bread recipes to counter the effect of potassium sorbate on the yeast and the effects of citric acid on the bread after-taste. Now, we have achieved a bread recipe with shelf-stable purée (1% citric acid, 0.25% sorbate and 0.25 benzoate) that takes an hour to proof to achieve the desired bread volume, and with no after taste from the citric acid which was countered by using baking soda (Table 1).

Table 1. Adjustment in Ingredients When OFSP Purée is Used in Fresh or Shelf-Stable Form

Ingredients	Bread formulations		
	100% Wheat Flour White Bread	Fresh OFSP Purée	Shelf-Stable OFSP Purée
Wheat flour (g)	3000	1800	1800
Fresh OFSP puree (g)		1200	
Shelf-Stable OFSP puree (g)			1200
Yeast (g)	45	45	75
Sugar (g)	120	120	120
Salt (g)	30	30	30
Fat (g)	90	90	90
Bread improver (g)	9	9	9
Baking powder (g)			15
Baking soda (g)			19.1

What's next?

The shelf-stable purée is quite appropriate for small to medium bakeries that are not negatively affected by the one hour proofing time and for products like chapatti that do not have to rise. To scale the shelf-stable OFSP purée for large scale applications such as large bakeries in Kenya, a more advanced shelf-stable OFSP processing that increases its shelf-life beyond six months and limits the use of chemical preservatives is desired. Also, developments in Kenya and Rwanda regarding use of plastic packaging mean we need to find alternative packaging solutions. We will explore the use of reusable, washable containers. We intend to investigate the use of hot filling (avoid chemical preservatives) and aseptic OFSP purée processing to produce shelf-stable OFSP purée with a shelf-life of 12-24 months in an effective and environmentally sustainable manner.

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