DEVELOPMENT AND ACCEPTABILITY OF HOME-MADE COMPLEMENTARY FOOD FROM COMPOSITE FLOUR OF PROVITAMIN A BIOFORTIFIED MAIZE

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Abstract: Complementary Food (CF) was developed from provitamin A biofortified maize to address the problem of Vitamin A deficiency (VAD) among rural children. Three composite flour blends were formulated using different ratio of Fermented Flour (FF) and Malted Flour(MF) of vitamin A biofortified maize, Soybean Flour (SF) and seasonings like Granulated Sugar (GS) and Crayfish Powder (CP). Composite flour blend1 contains (50% FF, 20% MF, 30% SF, 0% GS & 0% CP), blend2 (40% FF, 20% MF, 30% SF, 10% GS & 0% CP), blend3 (40% FF, 20% MF, 25% SF, 10% GS & 5% CP) while the ordinary maize slurry was used as the control. Each of the formulae was prepared into porridge and subjected to sensory evaluation of parameters like taste, texture, appearance, colour, gelatinousness, smell and overall acceptability. The home-made CF blend that was adjudged to be mostly acceptable among mothers was the one from blend 3 formulation with overall acceptability score of 3.88. It was concluded that this product could serve as a better alternative to the traditional watery maize gruel, usually prepared from maize slurry (control) which is deficient in micronutrients and commonly used as CF among the resource poor nursing mothers in rural households who could not afford the cost of commercial weaning foods.
Keywords: Complementary weaning food, vitamin A deficiency, rural children, acceptability

Introduction

Complementary Foods (CFs) are broadly categorized into commercially prepared and the homemade traditional CFs. Commercial CFs are produced using simple technologies such as malting, popping, fermentation, or modern food-processing technologies such as roller drying and extrusion cooking (Ng *et al*., 2012; Hotz & Gibson, 2007) while homemade CFs are prepared in traditional way at household level by the caregivers. While nursing mothers in developed countries widely use the commercial fortified CFs during child weaning, in many developing countries, they are often beyond the reach of the resource poor mothers. As a result, homemade complementary foods are frequently used (A2Z, 2010). In the light of this, Kuyper *et al*. (2013) observed that the basic food items used for the preparation of the home-made traditional complementary foods are usually based on locally available staples, while the choice of specific food item differs considerably between populations, owing to tradition, availability, and ease of access. These staples are majorly cereals, roots, and starchy fruits which mainly provide carbohydrate and energy (A2Z, 2010).

In several West African countries, the first and popular CFs are based on thin cereals with low intake of foods from meat, eggs, or fish, especially among low-income groups due to socio-economic factors, taboos, and ignorance (Onofiok and Nnanyelugo, 1998). In Nigeria, for instance, CFs are made from maize (*Zea mays*), millet (*Pennisetumamericanum*), or guinea corn (*Sorghum* spp.).Mothers usually perceived these foodsas easy to digest and having other relative advantages like availability, minimal cost, and ease of preparation. Olaniran *et al*. (2020) also reiterated that children in most developing countries are weaned with *ogi* because it is cheap and readily available. *Ogi* is a common fermented product produced from maize, sorghum or millet (Adelekan & Oyewole, 2010, Omemu 2011, Olaniran & Abiose, 2018). Recently, Olatunde *et al.* (2020) also developed CF from combination of millet, soybean and sweet potato. It has been that ascertained in literature that it is after successful introduction of cereal gruel that other staple foods in the family menu, such as yam (*Dioscorea* spp.), rice (*Oryza sativa*), *gari* (fermented cassava grits), and cocoyam (*Xanthosomasagittifolium*), are given to the children (Ogbonnaya *et al*., 2012; Onofiok and Nnanyelugo, 1998).

More importantly, CFs are expected to be rich in micronutrients like vitamins A, C and K, *iron,* zinc and calcium (WHO, 2003; 2009; FAO, 2011). Unfortunately, it has been reported that cereal gruels are inadequate to meet daily nutrients, energy and micronutrient requirements of children and where such form the main source of nutrient to an infant; it may lead to the problems of under-nutrition and micronutrient deficiency in infants and young children (Anju, 2002; Amina & Agle, 2004). One of the major challenges of traditional CFs therefore, is how to increase the density with multiple fortifications of essential micronutrients at affordable cost (Cordex, 2010).

Processing techniques like malting and fermentation also affect the nutritive value of the CFs. Malting involves the germination and sprouting of cereals. It provides a convenient method of increasing the energy density and digestibility of infant foods. During germination, starches are degraded into smaller molecules (dextrin and maltose), which absorb and hold less water than starches. When porridge is prepared from malted grains, it is thinner in consistency than normal porridge, therefore, making it possible to increase the energy content of malted grain porridge without making it thick. It also improves digestibility of cereals and the vitamin content in the prepared foods (NPFS, 2006). Fermentation enhances safety of CFs at the household level and contributes to the improvement of the nutritional value and digestibility of food materials. It improves nutrient density by increasing bio-availability of nutrients through degradation of anti-nutritional factors, pre-digestion of certain food components and the enhancement of absorption and uptake of nutrients (NPFS, 2006). It stimulates the growth of edible micro-organisms resulting in flavours, aromas and textures that are pleasant and attractive to the consumers (Osungbaro, 2009).

Vitamin A Deficiency (VAD) has been well reported in literature as a global challenge affecting children under 2 years of age (WHO, 2009; Gilbert, 2013). The release of two varieties of provitamin A bio-fortified maize (IITA hybrids A0905-28 and A0905-32) (IITA, 2012) by the International Institute for Tropical Agriculture (IITA), Ibadan, is a giant step to addressing the problem of VAD especially among the low-income rural households. These varieties have been popularized among farmers in Osun State by the Integrated Rural Development Programme of the Obafemi Awolowo

University, Ile-Ife, Nigeria. Replacement of common maize with provitamin A bio-fortified maize for the preparation of improved home-made CFs among nursing mothers will go a long way in eradicating VAD among children in rural households of the study area. However, there is dearth of information on development of composite flours from provitamin A bio-fortified maize and its acceptability for CFs production among nursing mothers, hence, this study.

Materials and Methods

Preparation of raw materials

Vitamin A bio-fortified maize (A0905-32 variety) was obtained from the Teaching and Research Farm of the Obafemi Awolowo University, Ile-Ife, Nigeria while the common yellow maize, soybean, sugar and crayfish were purchased from open market in Ile-Ife. 30% of the vitamin A biofortified maize was malted. The process of achieving malting is illustrated in Fig. 1. The remaining 70% of the maize was fermented in room temperature for 72 h, washed, sundried and grinded into flour as shown in Fig. 2. Soybean was blanched, soaked for 6-8 hours, sundried, dehulled and grinded into flour as shown in Fig. 3. The traditional method was used to produce the maize slurry that served as the control as illustrated in Fig. 4.

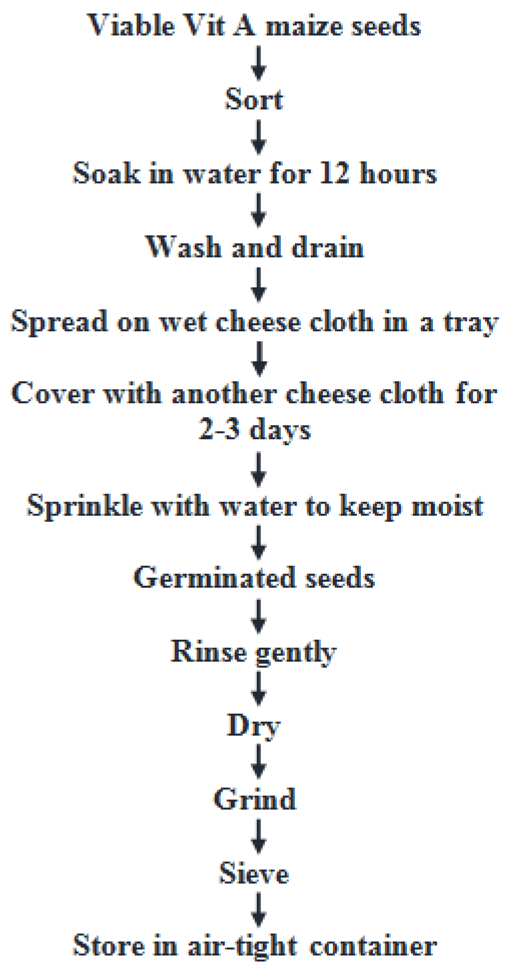

Fig. 1: Flow chart for production malted maize flour

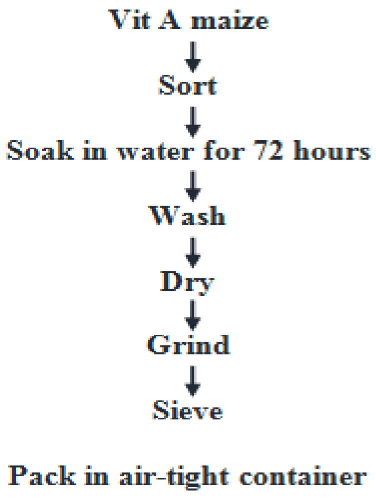

Fig. 2: Flow chart for production fermented maize flour

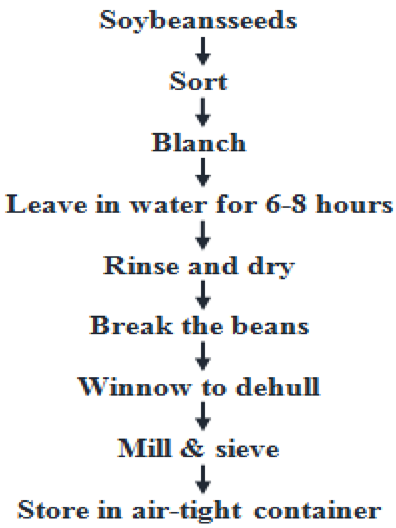

Fig. 3: Flow chart for production soybean flour

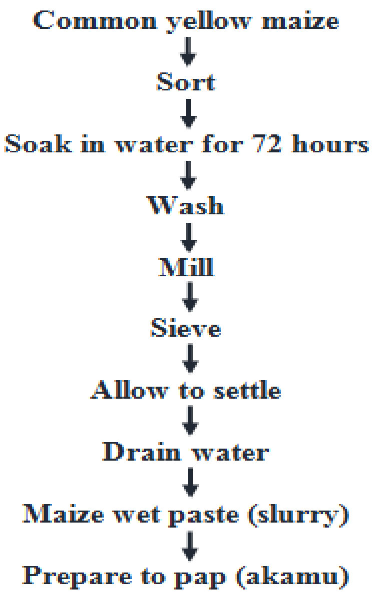

Fig. 4: Flow chart for production traditional wet maize paste

Formulation of the composite flour

Table 1 shows the three types of composite flours that were formulated. Granulated sugar and crayfish powder were used to serve as seasonings to the blends. Composite flour blend1 (the plain type with no seasoning) contains 50% Fermented Flour (FF) and 20% Malted Flour (MF) of vitamin A bio-fortified maize with 30% well processed Soya Flour (SF), 0% Granulated Sugar (GS) and 0% Crayfish Powder (CP).Composite flour blend 2 (with one seasoning) is made up of 40% FF, 20% MF, 30% SF, 10% GS and 0% CP. Composite flour blend 3 (with granulated sugar and crayfish powder) is a combination of 40% FF, 20% MF, 25% SF, 10% GS and 5% CP. Sugar (10%) was added to taste and to increase the energy content of the CF while incorporation of soybeans into the food was done to increase its nutritional content (Balogun *et al*., 2012) because soybeans provides a source of low- cost protein with good nutritional value (Iwe, 2003). It is a good substitute for animal products and offers a complete protein profile (United State Food and Drug Administration, 2001).

Table1: Showing formulation of Provitamin A based composite flour

Flour type	Fermented maize flour (%)	Malted maizeflour (%)	Soybeans flour (%)	Granulated sugar (%)	Crayfish powder (%)
Blend1	50	20	30	-	-
Blend2	40	20	30	10	-
Blend3	40	20	25	10	5
Control	100% maize slurry				

Preparation of the porridge

Each of the composite flour and the control was prepared into porridge by boiling. 100 ml of cold water was added to 100 g of each of the composite flours to form the paste which was later added to 500 ml of boiling water and allowed to cook for 10 min. In all, the flour to water ratio was 1:3 as recommended by Onoja *et al.* (2014). The traditional (100%) maize slurry was used to prepare the porridge used as the control CF.

Sensory evaluation

Sensory evaluation of the prepared porridges was carried out by a panel of judges made up of 10 nursing mothers per replicate and measured on a 1-4 acceptability scale. The parameters evaluated included taste, texture, appearance, colour, gelatinousness, smell and overall acceptability. Three replicates were carried out at one per selected LGA. The data collected were analysed using ANOVA while the means were separated by Duncan multiple range test.

Results and Discussion

Table 2 shows the result of the sensory evaluation for CF blends rating for all the sensory parameters tested. The taste result ranged from 3.74 – 1.84 with blend3 having the highest taste score while the lowest score was obtained from blend1. Texture result ranged from 3.70 (blend 3)-3.32 (control). Appearance result ranged from 3.74 (blend 3 – 3.30 (control). The colour result was similar for all the treatments. Blend 2 recorded the highest score (3.68) for gelatinousness result while the control recorded the least (2.50). Blend 3 has the highest score (3.68)for smell result while the control has the least (3.40). The overall acceptability result ranged from 3.88 – 1.98 with blends 3 and 1 having the highest and the lowest scores, respectively. The results show further that, at $P< 0.05$, there is significant difference in the taste and texture of the porridge produced from all the composite flour blends but there is no significant difference in the taste and texture of porridge produced from composite flour blend two and that of the control. There is significant difference in the appearance of porridge produced from composite flour blend three and those produced from blend one and the control. There is no significant difference in the colour of porridges produced from all the treatments. Significant difference exists in the gelatinousness of porridge produced from the control and those produced from all the 3 composite flour blends. Also, there is significant difference in the smell of porridge produced from composite flour blend three and those produced from all the other treatments. Generally, porridge from composite flour blend three has the highest scores in all the parameters except in gelatinousness. The implication of the finding is that home-made CF from composite flour of provitamin A maize using blend 3 formulation was the most acceptable to nursing mothers in the study area.

Table 2: Sensory evaluation of vitamin a biofortified maize-based complementary foods from four treatments

Parameter	Blend 1	Blend 2	Blend 3	Control	LSD
Taste	1.84^{c}	3.14^{b}	3.74^{a}	2.96^{b}	0.078
Texture	3.42^{c}	3.56^{b}	3.70^{a}	3.32^{b}	0.036
Appearance	3.60^{b}	3.68^{ab}	3.74^{a}	3.30^{b}	0.032
Colour	3.74^{a}	3.76^{a}	3.76^{a}	3.72^{a}	0.010
Gelatinousness	3.66^{a}	3.68^{a}	3.66^{a}	2.50^{c}	0.013
Smell	3.48^{b}	3.64^{b}	3.68^{a}	3.40^{b}	0.046
Overall acceptability	1.98^{c}	3.16^{b}	3.88^{a}	2.98^{b}	0.038

a,b,c = Means in the same row followed by the same letter are not significantly different from each other at $p< 0.05$

Table 3: Correlation matrix showing relationships among sensory evaluation parameters

Parameter	Taste	Texture	Appearance	Colour	Gelatinousness	Smell	Overall Acceptability
Taste							
Texture			0.504**	0.535**	0.600**		
Appearance					0.641**	0.364**	
Colour			0.664**		0.572**		
Gelatinousness						0.379**	
Smell							
Overall Acceptability	0.549**						

****** Significant ($P < 0.01$)

Results in Table 3 show the relationship among the sensory evaluation parameters. At $p \leq 0.01$, only taste was positively and significantly correlated with overall acceptability of the home-made CFs implying that taste is the major parameter and determinant of the CFs acceptability among mothers. Taste is an important attribute watched out for in any food product. It is the sensation of flavour perceived in the mouth on contact with substrate while overall acceptability refers to the general acceptance of the product with reference to all the discriminating sensory attributes of the samples (Babayeju *et al*., 2017). The taste of the CFs could be affected by the type and quantity of the ingredients used for seasoning (sugar and crayfish powder) in agreement with Ogundele *et al*. (2015) that variation in taste depends on the composition of the raw materials used in the preparation of the samples. Therefore, in order to enhance the adoption of home-made CFs from composite flour of provitamin A maize, the processing method and formulation ratio used for obtaining blend 3 should be taught to the nursing mothers by relevant home economics extension personnel.

Conclusion and Recommendation

The study revealed that home-made CF from composite flour of provitamin A maize using blend 3 formulation was the most acceptable and preferred above the traditional watery maize gruel commonly used for weaning by the resource poor nursing mothers who could not afford the cost of commercial weaning foods. It was therefore concluded that, in order to eradicate VAD among children in the study area, blend 3 formulation should be popularized as it will serve as a better alternative to traditional maize slurry (control) which is deficient in micronutrients. It was recommended that home economics extension personnel should organize adequate training for nursing mothers in rural households on the preparation of the blend and the porridge.

Conflict of Interest

Author declares that there is no conflict of interest.

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