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The Prospects and Challenges of Composite Flour for Bread Production in Nigeria

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THEPROSPECTSANDCHALLENGESOFCOMPOSITEFLOURFORBREADPRODUCTIONINNIGERIA

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Abstract- Due to changes in lifestyle and urbanization, the consumption of bread has increased in Nigeria and other developing countries. Since, wheat cannot perform well under tropical climate, the country had over the years dependent on wheat imports mostly from the United States. Wheat importation had had detrimental effects on the Nigerian economy. In order to reduce the impact on the economy, Nigeria released policy mandating the flour mills to partially substitute wheat flour with 40% cassava flour for bread making. The potential benefits of the policy include Savings of the Nigeria's foreign exchange earnings of N 254 billion (1$ = N156) per annum, reduction in the severity of coeliac disease, utilization of locally available crops and creation of employment and wealth. Substitution of wheat with other flour to the tone of 40% would require improvers, which have to be imported. Other potential challenges of the policy include poor quality of the bread, weak cassava flour supply chains, strong consumer preference for 100% wheat bread, and the reluctance of millers to use composite flour. Except the aforementioned challenges are adequately addressed, the 40% wheat flour substitution may fail like previous attempts.

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I. Introduction

Of recent, the consumption of bread has increased considerably in Nigeria (Shittu et al., 2007; Malomo et al., 2011; Odedeji and Adeleke, 2010), other African countries (Ogunjobi and Ogunwolu, 2010; Adebowale et al., 2012; Komlaga et al., 2012), Latin America (Best et al., 1988; Moreno-Alvarez et al., 2009) and Asia (Das et al., 2012) due to population increase and urbanization, the changing preference for convenient foods particularly snacks and increased wealth in the tropical world (Seibel, 2006). Unfortunately, wheat is a temperate crop that will not do well under tropical conditions due to unfavorable soil and climatic conditions (Abdelghafor et al., 2010; Edema et al., 2005). Hence, wheat consuming countries located in the tropical regions, which are mostly developing nations, rely on countries located in the temperate regions, mostly developed nations, for wheat importation. Dendy (1992) reported a simple correlation between the increase in urban population and the increase in wheat imports by developing countries. Many developing nations spend huge amount of their foreign exchange for the importation of food especially wheat, rice and sugar. For instance, in 2011 Africa spent more than $ 50 billion on food imports (Babatunde, 2012). Nigeria spends $ 3.7 (Adebayo, 2012; Agboala, 2011), $ 4.2 billion (Adeniyi, 2012; Olanrewaju, 2012; Sawyerr, 2012; Adeloye, 2012) yearly for the importation of wheat. According to Momoh (2011), in 2010 alone, Nigeria spent N 635 billion ($ 4.2 billion) on the importation of wheat, N 356 billion on the importation of rice, N 217 billion on sugar and N 97 billion on fish. It has been reported that wheat importation is growing at the rate of 13% per annum. It has been estimated that at this growth rate, Nigeria wheat importation could reach 17 million metric tonnes (MMT) by 2020, which is equivalent to the entire wheat production by Canada (the third largest wheat producing country in the World (Olanrewaja, 2012; Adeniyi, 2012). Similar increases have been reported in other developing countries, though to a lesser extent which Dendy (1992) estimated as 10% annum.

The unbridled importation of food by developing countries is detrimental to their local economy and threatens food security. Many developing countries spend a large proportion of their foreign exchange earnings on food especially wheat. By so doing, developing countries create wealth and employment in developed countries to the detriment of their local economy. Food importations especially from distant countries also have some sustainability challenges such as increase in food miles and energy consumption for food transportation. It is therefore of economic importance if wheat importation is reduced by substitution with other locally available raw materials (Onyeku et al., 2008) such as cassava, maize, potato and other carbohydrate flours.

In order to reduce the import dependency of developing countries, the Food and Agricultural Organization (FAO) in the 1960s spurred research on composite bread (Onyeku et al., 2008; Seibel, 2006; Owuamanam, 2007). Seibel (2006) reported that it is well known that no other crop can achieve the baking properties of wheat, hence, composite flour has become the subject of numerous studies. The number of publications on the subject was well over 1200 by 1993 (Dendy, 1993). Wheat is the ideal flour suited for bread making. Hence, the dilution and/ or substitution of wheat by other locally available flour for bread making could reduce bread making and the quality of the bread.

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Over the years, there have emerged two definitions of composite flour. Composite flour is a blend or mixture of wheat with other materials to form suitable flour for baking purposes (Dendy, 1992, 1993; Onyeku et al., 2008). Sanni et al. (2004) defined composite flour as the name given to wheat that has been diluted with non-wheat materials like cassava, maize and soybean. Of recent, composite flour is now defined as a blend of wholly non-wheat flours for the purpose of baking (Dendy, 1993). Putting both definitions together, Seibel (2006) defined composite flour as a mixture of flours from tubers rich in starch (e.g. cassava, potatoes, yam) and / or protein-rich flours (soybean, ground nut) and /or cereals (maize, rice, millet, sorghum) with or without wheat flour. Some of the documented advantages of composite flour for bread production in developing countries include savings of foreign exchange, promotion of high yielding native species, a better supply of proteins for human nutrition, enhancement of domestic agriculture, generate rural income and support rural development (Seidel, 2006; Bugusu et al., 2001; Andrae and Beckman, 1985). Because of these and other advantages, Nigeria and many developing nations have implemented composite flour policies. Hence, the aim of this study is to present the prospects and challenges of composite bread production in developing countries, with Nigeria as a case study.

II. Statistics of Wheat Importation in Nigeria

Historical data of wheat importation into Nigeria from 1934 to date was compiled from several sources such as Andrae and Beckman (1985), Balami et al. (2011) FAOSTAT etc and are summarized in Figure 1. The data show that wheat importation increased from 3, 600 tonnes/annum in 1934/38 to over 4 million tonnes in 2010, which declined slightly to 3.9 million in 2012. With the 13% annual growth rate, it is estimated that wheat importation into Nigeria could reach 17 million tonnes/annum by 2020 (Adenyi, 2012; Olanrewaju, 2012). Over the years, there was a steady rise in wheat importation except in instances (1987- 1990) where government policies on wheat affected wheat importation. Nigeria imports over 90% of her wheat from the US. Until recently, Nigeria used to be the number one destination in the World for US wheat. Even, now that Nigeria has dropped to the third position, she remains the most consistent and loyal consumer of US wheat (Nicely et al., 2011).

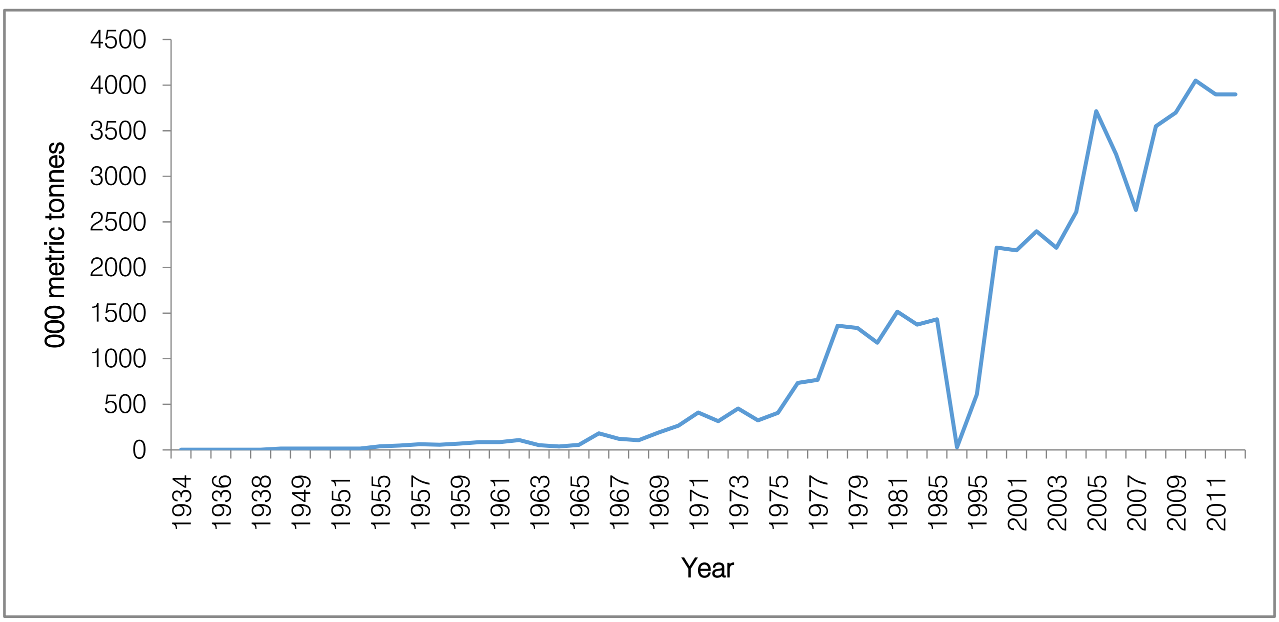

Figure 1 : Nigeria's wheat importation statistics

III. Nigeria Wheat Policy

The Nigeria wheat policy though have been unstable over the years, is specifically targeted at partially substituting wheat using domestically grown cassava. Nigeria is the largest producer of cassava in the world, which currently stand at almost 40 million metric tonnes/annum. Over the years, Nigeria wheat importation policy changes along with political/regime change. The country planned to substitute wheat with cassava by 10% in 1979 – 1983 (Adeloye, 2012) and 1999 – 2007 (Shittu et al., 2007; Adeniyi et al., 2010) and was reduced to 5% in 2007 – 2010 (Adeloye, 2012), while in 1987 – 1990, there was a complete ban on wheat importation in Nigeria (Mkpong et al., 1990; Falade and Akingbala, 2008; Sanni et al., 2004). During the period of complete ban, wheat was grown in Northern Nigeria under irrigation. During the period of ban, it was reported that domestic wheat production in Nigeria was a mere 2.7% of wheat consumption (Dendy, 1992). The locally produced wheat was about 6 - 8 times more expensive than imported wheat (Andrae and Beckman, 1985), hence the ban could not be sustained. Other wheat substitution policies (5 – 10%) similarly failed due to several factors such as refusal of mills and bakers to use composite flour, poor enforcement of the policies due to weak institutions, inability of cassava millers to supply enough flour (250,000 MMT/year), poor quality of cassava flour produced by smallholders, weak cassava flour supply chains, high cost of cassava flour, strong consumer preference for 100% wheat bread etc. The current regime of President Goodluck Jonathan (2010 – date), notwithstanding the failure of previous attempts even at lower cassava-wheat substitution ratios, have increased the cassava inclusion in composite flour to 40% with effect from 15 July 2012.It is expected that wheat substitution could reduce the cost of bread production in the country (Ogunjobi and Ogunwolu, 2010; Sanni et al., 2004).

Table 1 : Nigeria wheat substitution policy incentives and potential benefits

Policy aspect	Content
Cassava bread policy	Nigeria is committed to the inclusion of 40% cassava in composite flour with effect from 15 July 2012
	The policy provided for a changeover period of 18 months for flour miller and bakers to switch to composite flour.
Policy incentives	Waivers on the importation of bread improvers, cassava processing and flour milling equipment
	12% tax reduction on cassava flour utilization for flour millers
	Provision of free starter packs of composite flours and bread improvers for 100 kg of bread for smallholder bakers
	Provision of 100kg fertilizer at 50% discount and 15 bundles of improved cassava varieties for free to smallholders cassava farmers
	Additional 65% duty on wheat flour importation to the initial 35% duty (total duty 100%) and 15% duty to the initial 5% duty on wheat grain (total duty 20%)
	Creation of cassava bread development fund to be funded by the excess money realized from the importation of wheat, which shall be used for training, research, development and demonstration
	Training of about 400,000 master bakers in Nigeria
	Provision of loans to cassava processors for the purchase of equipment
	Ban on the importation of cassava flour
Potential benefits	Savings of the Nigeria's foreign exchange earning of ₦ 254 billion per annum
	Reduction in the severity of coeliac disease via gluten dilution
	Utilization of locally available crops, thus eliminating glut
	Creation of massive employment in both farm operation and flour milling leading to an improved source of income and livelihood

IV. Prospects of Composites Flour/Bread Production in Nigeria

Table 2 and 3 present the summary of research that has been carried out in search of credible alternatives for wheat substitution in bread, noodles and biscuit making. Most of the studies focused on cassava, other root crops/tubers (yam, coco-yam, sweat potato), grains (maize, rice, sorghum, millet), legumes/oil seeds (soya, chick-pea, cowpea, peanut) and some underutilized crops (bread fruit, bread nut, tiger nut). Most of the studies revealed that wheat can be substituted by 5 – 10% without significant detrimental effects on bread making and quality. Wheat can be substituted at higher levels, but beyond 20%, additives may be required to maintain bread quality such as emulsifiers, enzymes, hydrocolloids and other improvers. The use of these additives could increase the cost of bread production; it would require installation of new equipment and training of bakers and millers. Notwithstanding, 40 – 100% substitution of wheat flour by cassava have been reported for biscuit (Table 3). Composite flour has generally found wide applications in food, feed and chemical industries (Ogunjobi and Ogunwolu, 2010; Balagopalan, 2002).

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Table 2 : Flour sources for partial or complete

crop	Botanical name	Level of incorporation, %	References
Cassava	Manihot esculenta	70%-cassava flour or starch and 30% peanut and or soy flour	Seibel (2006)
		60% - cassava and 10% soybean	Sanni et al., 2004; Sanni et al., 2007
		70% - cassava and 7.5 % soybean	Sanni et al., 2007
		50% cassava starch, 20% milk powder and 30%-soy flour	Seibel (2006)
		60% cassava, 15% peanut	Seibel (2006)
		30% cassava and 10% soybean	Taiwo et al., 2002
		10% cassava, 5% cowpea	Oladunmoye et al., 2010
		12% cassava and 3% soya flour	Best et al., 1988
		15%	Best et al., 1988
		5% cassava, 5% cowpea	Oladunmoye et al., 2010
		30%	Defloor et al., 1994; Defloor et al., 1995; Khalil et al., 2000; Grace, 1977
		5 – 20%	Abass et al., 1998
		5 – 15 %	Ituen and Ituen 2011
		100%	Oyewole et al., 1996
		40%	Morton, 1988; Eggleston et al., 1993; Omoaka and Bokanga, 1994
		10%	Ogunbanwo et al., 2008; Aboaba and Obakpolor, 2010; Shittu et al., 2007; Oyeku et al., 2008
		20 %	Komlaga et al., 2012
		10 and 20%	Eddy et al., 2007; Aboaba and Obakpolor, 2010
Sorghum	Sorghum bicolor	100%	Seibel, 2006
		30%	Munck, 1995; Aluko and Olugbemi, 1989; Olatunji et al., 1992
		20%	Abdelghafor et al., 2011
		70% sorghum and 30% cassava	Olatunji et al., 1992
		70% sorghum and ≤30% corn	Schober et al., 1995
Coco yam (Taro)	Colocasia esculenta	20 %	Eddy et al., 2012
		30 – 50 %	Sanful et al., 2011
		10 %	Ammar et al., 2009
Coco yam	Xanthosoma sagittifolium	50 %	Eddy et al., 2012
Sweet potato		25%	Idolo, 2011
		10%	Wu et al., 2009
		20%	Chen and Chiang, 1984
Yam	Dioscorea esculenta	20%	Ukpabi, 2010
Rice	Oryza sativa	35%	Veluppillai et al., 2010
		20%	Mepba et al., 2007
		15%	Noomhorm & Bandola, 1994
Breadfruit	Artocarpus integrifolia	15%	Malomo et al., 2011
Breadnut	Artocarpus atilis	15%	Malomo et al., 2011
Chickpea	Cicer arietinum L	15 and 30 %	Hefnawy et al., 2012
Flaxseed	Linum usitatissimum	12 %	Hussain et al., 2011
Tiger nut	Cyperus esculenta	10 %	Ade-Omowaye et al., 2008
Plantain	Musa paradisiacea	22%	Muranga et al., 2010
		20%	Eddy et al., 2007;
		5%	Mepba et al., 2007
Maize	Zea mays	50%	Brites et al., 2007
		5% maize and 5% cowpea	Oladunmoye et al., 2010
		30%	Grace, 1977
Cactus pear	Opuntia boldinghii	5 – 10%	Moreno-Alvarz et al., 2009
Pumpkin	Curcurbita moschata	5%	See et al., 2007

Table 3 : Composites flour for the production of biscuits and noodles comparable to whole wheat

Common name	Botanical name	Level of incorporation, %	Type of products	References
Cassava	Manihot esculenta	60% - cassava, 30%-wheat and 10%	Noodle	Sanni et al., 2004, 2007

		soybean		
		70% - cassava, 27.5%-wheat and 7.5 % soybean	Noodle	Sanni et al., 2007
		50% cassava starch, 20% milk powder and 30%-soy flour	Biscuit	Seibel (2006)
		60% cassava, 15% peanut and 25% wheat flour	Noodle	Seibel (2006)
		100%	Biscuit	Oyewole et al., 1996
		40%	Biscuit	Morton, 1988; Eggleston et al., 1993; Omoaka and Bokanga, 1994
Chick pea	Cicer arietinum	50 %	Biscuit	Doxastakis et al., 2002; Navickis, 1987
Soy		40% soy, 30% maize and 30% wheat	Noodle	Seibel (2006)
Sorghum/millet		100%- Sorghum/millet flour	Biscuit	Seibel (2006)
Maize	Zea mays	80%-pre-gelatinized maize flour and 20% soy flower	Noodle	Seibel (2006)
Breadfruit	Artocarpus integrifolia	15%	Biscuit	Olaoye et al., 2007
Cashew apple	Anacardium occidentale	20% substitution for cassava	Biscuit	Ogunjobi and Ogunwolu, 2010
Sorghum		10%	Biscuits	Adebowale et al., 2012

Forty percent cassava inclusion in composite bread policy could create a demand of 1.2 million tonnes of high quality cassava flour (HQCF) annually. This large demand has the potential to boost farm income, create employment and wealth, mitigate rural-urban drift and generally support rural development. Farm and non-farm business enterprise could be enhanced. In support of the policy, the Federal Government have provided loans to farmers and have reduced the cost of registering business by 50%. This could increase the contribution of the agricultural sector to the country's GDP. Currently, the Nigerian agricultural sector contributes only 40% to the GDP while employing 70% (Oota, 2012). Substitution of wheat by cassava to the tone of 40% could greatly reduce or dilute the gluten content and thereby reduce the severity of patients suffering from coeliac diseases (Houben et al., 2012; Alvarenga et al., 2011). Wheat milling removes the fibrous layer of the grain, and in the process approximately 45% of the grain protein is lost, along with 80% of the fibre, 50 – 85% of vitamins, 20 – 80% of minerals, 35 – 55% of amino acids and up to 99.8% of phytochemicals (Rosell, 2011). Wheat is known to have a protein content of about 8% (Bokonga, 1995), hence wheat substitution provide an opportunity for improving the nutrient content of bread. For instance, cassava (Aniedu and Omodamiro, 2012; Omodamiro et al., 2012) and other crops such as pumpkin (See et al., 2007) and cactus (Moreno-Alvarez, 2009) containing pro-Vitamin A (β-carotene) have been added to bread. A study has shown that bread produced by substituting wheat with 25% sweet potato can increase the energy, vitamin A, B6 and C and magnesium content of the resulting composite flour. Legumes, which are known to contain 3 times the protein contents of grains, have also been used to increase the nutrient content of composite bread. Chickpea flour at 15 – 30% substitution (Hefnawy et al., 2012), cowpea at 5 – 10% substitution (Oladunmoye et al., 2010; Butt et al., 2011) and 15% soya (Olaoye et al., 2006) produced bread of improved nutritional quality. Dried legume seeds have been reported to generally promote slow and moderate post prandial blood glucose increase (Hefnawy et al., 2012), which is generally better for diabetes than 100% wheat bread. A study has shown that some of the crop used for the production of composite flour such as cassava and maize have lower glycemic index than wheat (Fasanmade and Anyakudo, 2007). Through cassava flour fortification, dietary fibres have been enhanced in bread (Jisha and Padmaja, 2008). Also composite bread could be fortified with medicinal herbs (Das et al., 2012) and oil seeds (Nedeem et al., 2010; Hussain et al., 2011) for health benefits.

V. Challenges of Composite flour for Bread Production

Several challenges could be encountered in the implementation of cassava-wheat composite bread policy. One of them is the policy itself. The Nigerian

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policy. One of them is the policy itself. The Nigerian wheat policies have changed at least five times since 1979. The policy has changed from successive Government during this period. Hence, stakeholders are skeptical of the stability of the current policy. Cassava milling is quite different from wheat milling. The implementation of the policy will require major modification of the mills, which could be costly. It will also require the training of millers and bakers, which the government has already started.

The full implementation of the Nigerian cassava bread policy will require 1200 metric tonnes of HQCF per annum. The country had failed to implement 5-10% cassava inclusion policy in the past. It is therefore inconceivable that such a country will attempt to implement 40%. Studies have shown that at 10% inclusion, bread of adequate quality can be produced without the need of improvers. But at 40%, improvers will be required. These improvers are not produced in Nigeria, but will have to be imported at heavy costs. Why would Nigeria reduce wheat import and start the importation of improvers?

The Nigerian bread policy was specific on the use of cassava for the production of composite bread. But as part of the agricultural transformation agenda (ATA) of the present and immediate past government, cassava have been used mostly for food (85 – 90% of total production), feed composition (mostly fish and poultry) and for manufacturing purposes such as textile, paper, beverages, glue/gum industry. Also, the same government have implemented the Nigeria biofuel policy, which selected cassava for the production of fuel ethanol for transportation (Ohimain, 2010, 2013) and cooking purposes (Ohimain, 2012). With all these multiple uses of cassava, it is doubtful if the quality of flour required by the millers could be met. In Nigeria, HQCF is mostly supplied by smallholders. These smallholders where unable to supply the 200,000 – 300,000 tonnes of HQCF needed for 10% cassava flour inclusion in composite flour (FGN, 2006). Hence, 40% will present a greater challenge. Other local alternative crops such as yam, maize, sweet potatoes and cowpea are also in short supply (Nicely et al., 2011). In addition, most of the Nigerian mills are controlled by wheat traders and others with negative views on composite flour (Dendy, 1992).

Sanni et al. (2005) summarized some of the major problems threatening the cassava bread policy to include weak HQCF supply chains, strong consumer preference for 100% wheat bread, and the reluctance of millers to use composite flour. Some bakeries that have used composite flour in the past had reported some quality challenges including high sand content, foul odour, shorter product shelf life, gradual discoloration, unreliable supply, brittleness and poor final product quality due to the use of partially fermented cassava flour (FGN, 2006).

VI. Conclusion

Due to changes in lifestyle and urbanization, bread consumption is increasing in many developing nations including Nigeria. But tropical climate cannot support the growth of wheat; the crop ideally suited for bread production, hence, the country had over the years dependent on wheat imports mostly from the United States. Wheat importation had had detrimental effects on the Nigerian economy. In order to reduce the impact on the economy, Nigeria released policy mandating the flour mills to partially substitute wheat flour with 40% cassava flour for bread making. The potential benefits of the policy include Savings of the Nigeria's foreign exchange earnings of N 254 billion per annum, reduction in the severity of coeliac disease, utilization of locally available crops and creation of employment and wealth. Studies have shown that cassava, other root crops/tubers (yam, coco-yam, sweat potato), grains (maize, rice, sorghum, and millet), legumes (soya, chick-pea, and cowpea, peanut) and some underutilized crops (bread fruit, bread nut, and tiger nut) can be used to partially substitute wheat in bread making. Most of the studies revealed that wheat can be substituted by 5 – 10% without significant detrimental effects on bread making and quality. Though, wheat can be substituted at higher levels, but beyond 20%, additives may be required to maintain bread quality such as emulsifiers, enzymes, hydrocolloids and other improvers. The use of these additives could increase the cost of bread production; it would require installation of new equipment and training of bakers and millers. Other potential challenges of the policy include poor quality of the bread, weak cassava flour supply chains, strong consumer preference for 100% wheat bread, and the reluctance of millers to use composite flour. Except the aforementioned challenges are adequately addressed, the 40% wheat flour substitution may fail like previous attempts.

VII. Acknowledgement

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