PRODUCTION AND SENSORY EVALUATION OF CAKES FROM A COMBINATION OF WHEAT (TRITICUMAESTIVUM) AND ALMOND SEED (PRUNUSAMYGDALUSDULCIS)

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Abstract
The study investigated the production and sensory evaluation of cakes from a combination of wheat and almond seed. The study adopted experimental design method. The sensory characteristics namely colour, texture, taste, aroma, mouth feel and general acceptability were analyzed. Twenty (20) panelists were used to determine the sensory characteristics of the samples which consisted of wheat and almond flour blends. Data from the study on sensory evaluation were subjected to analysis of variance (ANOVA), the means where separated by Duncan's Multiple Range Test. Significance was accepted at p<0.05. Results indicated that the control sample (100% wheat flour cake) CWF4 ranked highest in all the attributes (colour 6.20±1.11; texture 6.15±1.09; taste 6.00±1.17; aroma 5.70±1.30; mouth feel 5.70±1.56) with the exception of the aroma. Although the scores of sample CWF4 were comparable to the scores of samples CWA1 (70% wheat:30% almond), CWA2(50% wheat;50% almond) and CWA3(30% wheat:70% almond) in terms of colour, texture, aroma and general acceptability, sample CWF4 differed significantly with 100% almond seed flour cake CAF5 in all the attributes (colour 4.55±1.93; texture 4.40±1.98; taste 4.70±1.89; aroma 4.35±1.95; mouth feel 4.00±1.89). Therefore, almond seed flour used in combination with wheat flour possesses good sensory qualities that can help reduce over dependence on wheat flour in cake production.

Key Words: Production, Evaluation, Cake, Wheat, Almond seed.

Introduction
Production of confectionary products from other flours such as almond seed flour could help reduce wheat importation and consequently increase consumption and utilization of indigenous foods (Adeniji, 2007). Almond seeds are valued for their sweet taste and crunchy texture. The Almond Board of California (ABC) (2012) report the majority (50%) of consumed almond seeds are used as an ingredient in manufactured goods such as candy, cereal, ice cream and cookies. The remainder are purchased as snacks, used in home baking and cooking (25%) or consumed at the food service level (25%) (Almond Board of California, 2012). Almond seeds are a common ingredient in cookies such as macaroons, ice cream, butters, snacks (mixed nuts, roasted and/or salted) and as a topping for desserts, salads, and vegetables.

Almond seeds are included in the family Rosaceae in addition to Pomoideae (apples, pears), Prunoideae (apricot, cherry, peach, and plum) and Rosoideae (blackberry, strawberry) fruits. Almond seeds (Prunusamygdalus) are of 2 types, sweet almonds (Prunusamygdalus 'dulcis') used mainly for culinary purposes and bitter almonds (Prunusamygdalus 'amara') used mainly in the making of oils and flavorings. The bitterness of the latter type is based on the presence of cyanogenic glycosides which can be degraded by glycosidases (present in the seedor produced by microorganism in the digestive tract of mammals) to generate hydrogen cyanide (HCN) which may potentially cause cyanide poisoning (Akpakpan and Akpabio, 2012). Almond seeds are valued for their sweet taste and crunchy texture. Almond (Prunusamygdalus L.) fruit characteristics have been documented by Etienne (2017). The peach-like edible almonds fruit (Prunusamygdalus) have three distinct parts: the inner kernel or meat, the middle shell portion, and an outer green shell cover or hull. Almond varieties vary in shell texture; hard or soft shelled. The harvesting procedure starts when the almonds are partly dried on the trees (Etienne, 2017). In addition the sweet almond is a stone fruit which have several unique features. It is commercially cultivated where there are long, hot, and Mediterranean like summers, such as those in Spain, Morocco, Armenia, Iran, Italy, California (USA), and Australia.

An almond fruit is unique. This is due to the fact that unlike others in its botanical family (such as peach, apricot and plum) where the flesh (mesocarp) of the fruit is eaten and the seed within its shell, or stone (endocarp) is discarded, the reverse is true for the almond early in its maturation cycle, for a period of a few weeks, the entire fruit (seed, endocarp and mesocarp) can be, and is, eaten, in several parts of the world. The hull splits open as the maturation cycle continues. When dry, it may be readily separated from the shell. The almond pit, containing a kernel or edible seed, is the nut of commerce, the endocarp (shell), and mesocarp are separated for low value uses, such as cat litter and animal feed (Rabinowitz, 2002; Rabinowitz, 2004). Shelled almonds may be sold as whole natural almonds or processed into various almond forms. The
whole natural almonds have their shells removed but still retain their brown skins; blanched whole almonds have both their shells and skins removed. Usually, the removed skins are discarded as documented by Chen, Millap, Lapsley, and Blumberg(2005); Lapsley, Dada, Nwawe, Okere, and Uwubanwuen (2002); Rosen., Davis, Edberg and Reasoner, (2002).

Almond seeds contain approximately 51% lipid, 21% protein, 20% carbohydrate and 12% fiber (USDA, 2007). The majority of lipids are mono unsaturated (67%) and polyunsaturated (25%) fatty acids (MUFA and PUFA, respectively) (USDA, 2007). Previous studies indicate the MUFA’s from almond seeds may reduce total cholesterol and low-density lipoproteins (LDL, “bad cholesterol”) while maintaining healthy high-density lipoproteins (HDL, “good cholesterol”) levels (Jenkins, Kendall, Marchie, Parker and Connely, 2002; Hyson, Schnneeman, and Davis, 2002; Sabate, Haddad, Tanzman, Jambazian and Rajaram, 2003; Griel, and Kris-Etherton, 2006).

Almond seeds are good sources of proteins, phosphorus, calcium, potassium, magnesium, manganese, copper, zinc, and iron (USDA, 2007; Akpabio, 2012; Akpakpan and Akpabio, 2012). Epidemiological studies have been remarkably consistent in showing an association between nut consumption and a reduced risk of cardiovascular disease (Sabate and Ang, 2009). The sensory analysis of cakes enriched with almond powders was undertaken by Etienne (2017). The work evaluated the sensory properties of nine cakes enriched with almonds powders of Terminalia catappa produced in Cote d'Ivoire. The study focused on the sensory properties (descriptive profile and hedonic analysis) of nine (9) cakes enriched with the powders of almonds of Terminalia catappa. The almond flour of T. catappa weakly influenced the sensory characteristics of the cakes. The study recommended enriching wheat flour with almond seed flour in cake production.

Wheat (Triticum aestivum) is the choice cereal for the production of cakes because it contains a large amount of gluten, which makes cakes rise. Wheat flour is unique among cereals. This is owing to the fact that, when mixed with water in the correct proportion, its protein component forms an elastic network capable of holding gas and developing a firm spongy structure when baked. The protein substances that contribute to these properties are known as gluten. The suitability of flour for a given purpose is determined by the type and amount of its gluten content. Low-protein, soft-wheat flour is appropriate for cakes, pie crusts, cookies and other products that do not require great expansion and elastic structure. High-protein, hard wheat flour is suitable for bread, hard rolls, soda crackers and Danish pastry because they require elastic dough and often expanded to low densities by the leavening action (Onwuka, 2014).

The Nigerian government spends huge amount of money on the importation of wheat flour. One of the major challenges faced by bakery industries in Nigeria is over dependence on importation of wheat to sustain it, since Nigeria's climate does not favour cultivation of wheat (Olapade and Oluwole, 2013). Therefore, any effort geared towards substituting part of wheat flour with indigenous seed such as almond will be useful. Advantages of using composite flours for developing countries such as Nigeria have been documented as follows: the saving of hard currency; promotion of high yielding indigenous plants; a better supply of protein for human nutrition; and better overall use of domestic agriculture production (Maxwell, Onyeke, Zubair, Femi, Jiya, and Ocheme, 2020).

The use of vegetable proteins, especially from underutilized or neglected seeds, oil seeds and legumes, as enrichment for ready-to-eat snack foods has been identified as a viable alternative for raising the nutritional level of teeming millions in different parts of the world. This is due to widespread shortage of animal proteins and malnutrition occasioned by a high population growth rate and poverty (Enujiugha and Ayodele-Oni, 2003). These and other factors necessitated the search for a relatively cheap substitute flour using underutilized cereals, legumes, root and tubers, nuts and seeds in the production of confectionary products. This prompted this research on the production and sensory evaluation of cakes made from a combination of wheat and almond seed flours.

Almond trees are available native plants that are rich in nutrients. The seed flour can be used in combination with wheat flour for cake production. Therefore, this research determined the production and sensory evaluation of cakes made from a combination of wheat and almond seed flours. This is a strategy for optimal consumption and utilization of indigenous seeds.

Objectives of the study
This study determined the production and sensory evaluation of cakes made from a combination of wheat and almond seed flours. Specifically, the study

i. Produced almond seed flour.

ii. Formulated composite flour mixtures using various ratios of flour combinations of wheat and almond seed.

iii. Produced cakes from the composite flour mixtures.

iv. Determined the sensory properties of the
cakes.

v. Evaluated the general acceptability of the cakes.

Research Questions
i. How can almond seed flour be produced?

ii. How can composite flour mixtures be formulated using various ratios of flour combinations of wheat and almond seed?

iii. How can cakes be produced from the composite flour mixtures?

iv. What are the sensory properties of the cakes?

v. What are the panelists’ assessment on the general acceptability of the cakes?

Materials and Methods
Design of the Study
Experimental research design was used for this study. Laboratory experiment which is classified under experimental design is conducted in an isolated physical setting where there is maximum control of conditions (Nworgu, 2006). Experimental design was considered appropriate for the study because it involved laboratory experiment in the production and evaluation of cake from a combination of wheat and almond seed.

Sample collection
The almond seeds were collected from Michael Okpara University of Agriculture, Umudike, Abia State and National Root Crop Research Institute in Umudike, Abia State.

Sample preparation
Preparation of almond seed flour
The dried fruits were cracked using a nut cracker. The seeds extracted were sun dried for 4-6 days, milled into flour and sieved and stored in polythene bags until use.

Dried almond fruit

\[
\begin{align*}
\text{Cracked} & \\
\downarrow & \\
\text{Dried} & \\
\downarrow & \\
\text{Sieved} & \\
\downarrow & \\
\text{Almond fruit seed flour} &
\end{align*}
\]

Figure 1: Flow diagram from the processing of dried almond seed to flour.

Preparation of flour blends
Proportions of the flour blends or composites that were used for the production of the baked samples.

<table>
<thead>
<tr>
<th>Sample proportion of flour blends</th>
<th>Sample 101</th>
<th>Sample 102</th>
<th>Sample 103</th>
<th>Sample 104</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% - 30%</td>
<td>50% - 50%</td>
<td>70% - 30%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Almond seed flour</td>
<td>Wheat flour</td>
<td>Almond seed flour</td>
<td>Wheat flour</td>
<td></td>
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<tr>
<td>wheat flour</td>
<td></td>
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</tbody>
</table>

Preparation of baked sample
Salt ½ level teaspoon
Milk 30ml
Nutmeg 1 level teaspoon
Vanilla essence ½ teaspoon

Cake production
The cake samples were produced with various proportions of the composites flours.

Sample recipe
Flour 100g
Margarine 25g
Sugar 25g
Egg 1
Baking powder 1 level teaspoon
Method
1. Cream margarine and sugar in a mixing bowl until the mixture is fluffy and drops easily from a spoon.
2. Whisk the egg and add to the creamed mixture.
3. Sift flour baking powder, salt and nutmeg. Fold in the sifted ingredients little by little into the creamed mixture to form a stiff batter.
4. Add the vanilla essence and milk by properly folding them in. Grease the cake pans and fill 2/3 full with the batter.
5. Bake in moderately hot oven of 175°C for 25-30 min or until the cake shrinks from the pan or evenly brown.

Sensory evaluation
The texture, flavor (aroma), taste, colour and general acceptability were evaluated by twenty undergraduates of Michael Okpara University of Agriculture, Umudike, Abia State who served as panelists. The panelists rated their preferences for each attribute using the 7-point Hedonic scale.

Statistical analysis
Data from the study on sensory evaluation were subjected to analysis of variance (ANOVA), the means where separated by Duncan's Multiple Range Test (SPSS version 20). Significance was accepted at p<0.05.

Findings of the study
Table 1: Sensory characteristics of the cakes

<table>
<thead>
<tr>
<th>Cake samples</th>
<th>Color</th>
<th>Texture</th>
<th>Taste</th>
<th>Aroma</th>
<th>Mouth feel</th>
<th>General Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWA1</td>
<td>5.60±1.31</td>
<td>6.05±1.39</td>
<td>5.70±1.45</td>
<td>5.75±1.12</td>
<td>5.60±1.27</td>
<td>5.95±0.89</td>
</tr>
<tr>
<td>CWA2</td>
<td>5.45±1.19</td>
<td>5.80±1.11</td>
<td>5.65±1.35</td>
<td>5.50±1.67</td>
<td>5.10±1.77</td>
<td>5.65±1.23</td>
</tr>
<tr>
<td>CAW3</td>
<td>5.65±0.99</td>
<td>5.40±1.23</td>
<td>4.90±1.45</td>
<td>5.55±1.10</td>
<td>5.00±1.49</td>
<td>5.55±0.94</td>
</tr>
<tr>
<td>CWF4</td>
<td>6.20±1.11</td>
<td>6.15±1.09</td>
<td>6.00±1.17</td>
<td>5.70±1.30</td>
<td>5.70±1.56</td>
<td>6.35±0.99</td>
</tr>
<tr>
<td>CAF5</td>
<td>4.55±1.93</td>
<td>4.40±1.98</td>
<td>4.70±1.89</td>
<td>4.35±1.95</td>
<td>4.00±1.89</td>
<td>4.35±1.84</td>
</tr>
</tbody>
</table>

Values are means ±standard deviation of the responses of 20 panelists. *means with same superscripts in the same column are not significantly different.

Key:
CWA1 = 70:30 wheat flour : almond seed flour
CWA2 = 50:50 wheat flour : almond seed flour
CAW3 = 30:70 wheat flour : almond seed flour
CWF4 = 100% wheat flour
CAF5 = 100% almond seed flour

Table 1 showed the sensory properties of the cake samples. The control sample (100% wheat flour cake) CWF4 ranked highest in all the attributes (colour 6.20±1.11; texture 6.15±1.09; taste 6.00±1.17; aroma 5.70±1.30; mouth feel 5.70±1.56) with the exception of the aroma. Although the scores of sample CWF4 were comparable to the scores of samples CWA1, CWA2 and CAW3 in colour, texture, aroma and general acceptability, sample CWF4 differed significantly with 100% almond seed flour cake CAF5 in all the attributes. The study focused on the sensory properties (descriptive profile and hedonic analysis) of nine (9) cakes enriched with the powders of Terminalia catappa. This finding agreed with the study conducted by Etienne (2017) who worked on the sensory analysis of cakes enriched with almond powders. The study evaluated the sensory properties of nine (9) cakes enriched with almonds powders of Terminalia catappa produced in Cote d'Ivoire. The study focused on the sensory properties (descriptive profile and hedonic analysis) of nine (9) cakes enriched with the powders of almonds of Terminalia catappa.
The scores attributed to the different cakes were statistically identical. Means were high and ranged from 6.07/9 to 7.13/9. The profiles showed significant differences at $p < 0.001$ for fortified cakes at the perception level. The cake scores did not reveal statistical difference except for the colour of the crumb. However, at this profile, the color of the crumb was more noticeable in the F3 cake with a score of 8.11/10, while the F2 cake showed the lowest score (3.3/10). The almond flour of *T. catappa* weakly influenced the sensory characteristics of the cakes. The study recommended enriching wheat flour with almond seed flour in cake production.

There was no significant difference in the aroma of the samples, except for sample CAF5 (100%) almond seed flour (4.35±1.95) which recorded the lowest score for aroma. Result indicated that comparable sample CWA1, CWA2 and CWF4 had comparable values in mouth feel. Sample CAF5 (100%) almond seed flour (4.00±1.89) had the lowest score for mouth feel. There was no significant difference in the general acceptability of all the samples except for CAF5 (100%) almond seed flour (4.35±1.84) that had the lowest score. Research result also showed that blending wheat flour with almond seed flour did not affect the taste, aroma and mouth feel of the cake samples, it rather enriched it.

Finding on sensory characteristics of the cakes revealed that samples CAF5(100%) almond seed flour cakes showed the least scores in colour, texture, taste, aroma, mouth feel and general acceptability compared to other samples (CWA1, CWA2, CWA3 and CWA4). This result suggested that the blend of almond seed flour and wheat flour cakes were preferred to the almond seed flour cakes. Similarly, Enujiugha and Ayodele-Oni (2003) reported the use of vegetable proteins, especially from underutilized or neglected seeds, oil seeds and legumes, as enrichment for ready-to-eat snack foods has been identified as a viable alternative for raising the nutritional level of teeming millions in different parts of the world. This is due to widespread shortage of animal proteins and malnutrition occasioned by a high population growth rate and poverty.

**Conclusion**

The study demonstrated the potentials of almond seed and wheat flours in the production of cake. Research result indicated that blending wheat flour with almond seed flour enriched the cakes and were highly acceptable (in terms of taste, aroma and mouth feel of the cake samples) compared to 100% almond seed flour cakes. There were no significant differences in the general acceptability of all the samples except for CAF5 (100%) almond seed flour (4.35±1.84) that had the lowest score. Therefore, almond seed flour used in combination with wheat flour possesses good sensory qualities that can help reduce over dependence on wheat flour in cake production.

**Recommendation**

Based on the findings of the study, the use of almond seed flour in combination with wheat flour for cake production at a commercial level should be exploited.

**References**


