SENSORY ASSESSMENT OF COOKIES PRODUCED FROM BLENDS OF ORANGE-FLESHED SWEET POTATO, SOYBEAN, AND DATE FRUIT FLOURS

***Rita Ogodo Nwankwegu; e-mail: rita.nwankwegu@ebsu.edu.ng**
*** Department of Food Science and Technology, Faculty of Agricultural and Management Science, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria.**
Corresponding Author: Rita Ogodo Nwankwegu ORCID iD: 0009-0002-9999-6532

Abstract
This study assessed the sensory characteristics of cookies made from blends of orange-fleshed sweet potatoes, soybean, and date fruit flour. Four formulations were tested: Control (OSD1) with 100% wheat flour, and four test groups—OSD2 (80% orange-fleshed sweet potatoes, 15% soybean, 5% date flour), OSD3 (70% orange-fleshed sweet potatoes, 20% soybean, 10% date flour), and OSD4 (60% orange-fleshed sweet potatoes, 25% soybean, 15% date flour). OSD5 (50% orange-fleshed sweet potatoes, 30% soybean, 20% date flour). Sensory attributes evaluated included appearance, taste, texture, aroma, and acceptability, using a completely randomized design (CRD). ANOVA and Duncan's multiple range test (DMRT) were used for statistical analysis at $p < 0.05$. The control (OSD1) was rated highest across all attributes, with appearance, taste, and overall acceptability scores of 7.40, 7.20, and 7.30, respectively. Incorporating soybean and date flour (OSD2, OSD3, OSD4, OSD5) significantly ($p < 0.05$) reduced these scores, particularly for taste and aroma. While the test blends had slightly lower overall acceptance, they were still close to the control. The study suggests that adding soybean and date flour can enhance nutrient density, but careful attention is needed to maintain desirable sensory qualities.

Keywords: Sensory evaluation, Orange-Fleshed Sweet Potato, Soybean, and Date Fruit Flours

Introduction

Food product development, in general, has accelerated in the last few years due to the need to invent foods with medicinal properties, improved food Security, and improved consumer's preference of functional foods (Galanakis, 2021). Among such innovative solutions is the development of composite flours containing components from different food categories to improve nutritional and organoleptic characteristics of food. Blending orange-fleshed sweet potato (OFSP), soybean, and date fruit flours to produce cookies is indeed a worthy strategy. Apart from fortifying the nutritional value of the product, these ingredients add specific textural qualities that make them ideal for consumers desiring healthier alternatives to conventional cookies (Chandra *et aI*., 2015; Girard *et aI*., 2021).

Orange-fleshed sweet potato OFSP Ipomoea batatas is a vitamin A rich tuberous root crop containing pro-vitamin A, which is crucial in promoting and sustaining good vision, skin and immune system health (Guru, *et aI*., 2014; Neela *et aI* 2019). Lack of vitamin A is a major concern in the general population and more so in the tropical world hence OFSP has been sold as this biofortified crops (Neela, *et aI*. 2019). Owing to the addition of OFSP in fortified cookies, apart from providing nutrition to food products, it also changes the color and taste of the food items for a better consumer appeal. Besides, OFSP has dietary fibre that plays a role in supporting digestive system and assists in the management of blood sugar fluctuations (Rosell *et aI*., 2024).

Soybean (Glycine max) is a leguminous crop which is well known for their high protein and oil content and thus makes a good fit in many food products and primarily as ingredient in protein enhanced wheat baked foods (Kanimozhi, 2018). Soybean flour contains some essential amino acids that are crucial in muscle building, tissue rally and metabolic balance among the body (Qin *et aI*., 2022). In addition, soybeans have many other nutrients, including isoflavones, which are plant hormones with antioxidants believed to help decrease the risks of heart disease, cancer, and osteoporosis (Kim, 2021). Soybean could be used to fortify cookies to increase protein content, particularly important in nutritional, special population, including children, athletes and geriatrics. Moreover, soybean flour has good effects on the texture and structure of the baked products and enhances its mouthfeel acceptability (Akubor *et aI*., 2023).

Date fruits popularly known as Phoenix dactylifera produce natural sugars making sweeteners to be replaced in food products produced from it (Salomon-Torres *et aI*., 2021). Dates also contain other nutrients of dietary importance such as dietary fibre, potassium, magnesium, and natural antioxidants, flavonoids, carotenoids and phenolic acid, which are known to have anti-inflammatory and cardio protective features for human consumption (Siddiq *et aI*., 2020). Date fruit flour which can be incorporated into cookies adds natural flavouring to the cookies and markedly improves the product's nutritive value by enhancing the fibre and mineral values of the cookies as

against the regular sweetening agents. Additionally, the high antioxidant level indicated in dates brings about health advancement of cookies by shielding the body against oxidative harm and the potential risk of chronic ailments (Soomro *et aI*., 2023).

Sensory characteristics particularly colour, flavour, texture and Taste are also very important in acceptance of a food product. The production of OFSP, soybean, and date fruit cookie flours provides interesting qualities of sensory properties. OFSP provides a vibrant orange color and a slightly sweet, earthy flavor, while soybean flour contributes a mild, nutty flavor and enhances the protein content. The natural sweetness of date fruit flour not only improves the taste but also adds a chewy texture, which can enhance the overall eating experience (Liu, 2024; Siddiq *et aI*., 2020). The primary objective of this study is to evaluate the sensory characteristics and nutritional composition of cookies made from composite flours of orange-fleshed sweet potato, soybean, and date fruit. By assessing these attributes, this research aims to determine the potential of these innovative flour blends in producing healthier, more nutritious cookies that meet consumer preferences.

Materials and methods

Materials

Sources of raw materials

The orange-fleshed sweet potato, soybean, and date fruit used for this study were purchased from the International Market, Abakaliki, Ebonyi State, Nigeria. All chemicals and equipment used were of analytical grade.

Sample Preparation

Orange-Fleshed sweet Potato Flour Production

Orange-fleshed sweet potato flour was produced as described by Sebben *et aI*. (2015). The Tuber was washed, peeled, sliced and blanched at 80 ^{o}C. Then oven dried at 50 ^{o}C for 6 hours and milled in a hammer mill (Stedman, model 20 x 12) to pass through a 500 µm mesh sieve (British standard). Flour was stored in airtight plastic containers at room temperature (28 ^{o}C; 24 Relative humidity) until need, as shown in Figure 1.

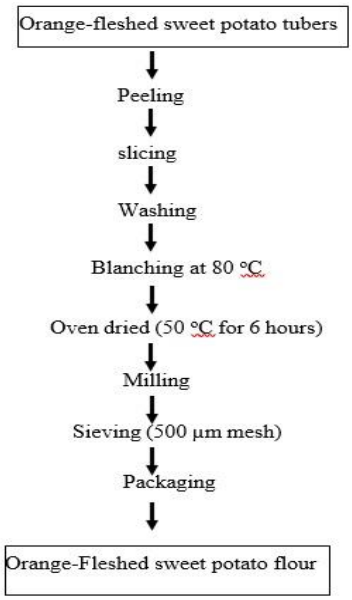

Figure 1: Orange-Fleshed sweet potato flour Production

Soyabean Flour Production

Soybean flour was produced according to the method described by Nwakalor and Obi (2014). The soybeans were sorted to remove pebbles, stones, and other extraneous materials. They were cleaned and steeped for 100 hours. After steeping, the soybeans were drained and dehulled by rubbing between the palms, and the hulls were removed by rinsing with clean water. The dehulled soybeans were then dried in a cabinet dryer at 70 °C for 7 hours and dry-milled into fine flour. The flour was sieved using a 500 µm aperture sieve to obtain a smooth texture. Finally, the soybean flour was packaged in a low-density polyethylene bag until use, as shown in Figure. 2.

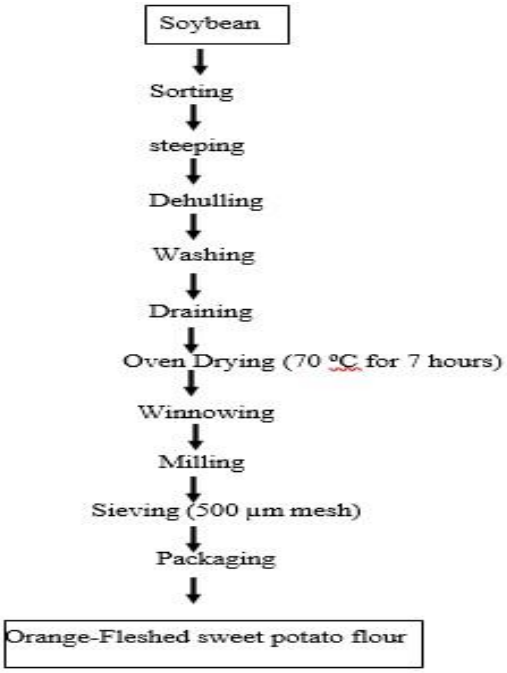

Figure. 2: Soybean flour Production.

Date Fruit Flour Production

Date palm fruit pulp flour was produced according to the method described by Peter-Ikechukwu et al. (2020). The fruits were sorted to remove pebbles, stones, and other extraneous materials. They were cleaned by washing to remove adhering dirt, followed by manual deseeding. The fleshy pulp was then cut into small pieces with a knife. The pulp, including the pericarp, was oven-dried at 75 °C for 6 hours and subsequently milled using an attrition mill (Atlas Exclusive, Alzico Ltd, Vill). The resulting product was sieved through a 500 µm mesh (U.S. standard sieve) to obtain fine flour, which was packaged at ambient temperature for use, as shown in Figure 3.

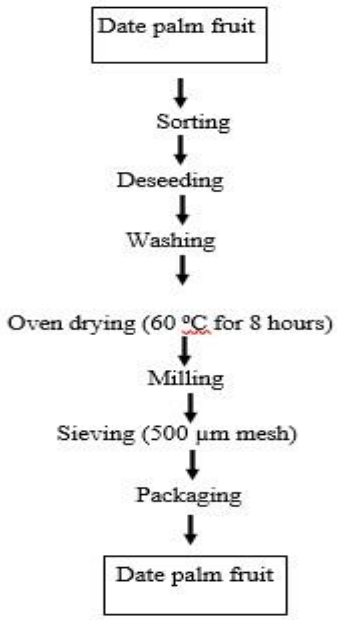

Figure 3: Flow chart for date palm fruit flour production.

Preparation of composite flour:

The orange-fleshed sweet potato, soybean and date fruit flours were blended as follows (OSD1 = 100% Wheat flour (control); OSD2=80 % Orange-fleshed Sweet potatoes flour, 15 % Soybean flour, 5 % Date flour; OSD3= 70% Orange-fleshed sweet potatoes, 20 % Soybean flour, 10 % Date flour; OSD4 = 60% Orange-fleshed Sweet potatoes flour, 25% soybean flour, 15% Date flour; OSD5 = 50% Orange-fleshed Sweet potatoes flour, 30% soybean flour, 20 % Date flour) according to Onu *et aI*., (2019) with slight modifications as illustrated in Table 1.

Table 1: Composition (%) of flour blends from blends of acha, pigeon pea and mushroom

Sample code	Wheat flour	Orange-fleshed sweet potatoes flour (%)	Soybean flour (%)	Date fruit flour (%)
OSD1 (Control)	100	0	0	0
OSD2	0	80	15	5
OSD3	0	70	20	10
OSD4	0	60	25	15
OSD5	0	50	30	20

Key: OSD1= 100% wheat flour (Control); OSD2=80 Orange-fleshed sweet potatoes flour %, 15% Soybean flour, 5 % Date fruit flour, 0 % Wheat flour; OSD3= 70 % Orange-fleshed sweet potatoes flour, 20 % Soybean flour, 10% Date fruit flour, 0 % Wheat flour; OSD4 =60 % Orange-fleshed sweet potatoes flour, 25 % Soybean flour, 15% Date fruit flour. OSD5 = 50 % Orange-fleshed sweet potatoes flour, 30 % Soybean flour,20 % Date fruit flour; 0 % Wheat flour

Methods

Determination of sensory Evaluation

The sensory properties of the cookies were evaluated by 20 semi-trained panelists drawn from the staff and student population of the Department of Food Science and Technology, Ebonyi State University, Abakaliki. The sensory attributes assessed included appearance, taste, flavor, texture, crispiness, and overall acceptability of the cookies. A 9-point hedonic scale questionnaire were:

9 represents extremely like,
1 represents extremely dislike while
5 represents neither like nor dislike according to Iwe, (2001).

Each sample were assigned a three-digit code and presented in a ceramic plate in a white lighted and quiet sensory evaluation room. The samples were served with milk thereafter another batch of the sample were served dry in a randomized order with potable water and cup for rinsing of mouth in-between tasting of samples to minimize rating errors, due to carryover of perceived attributes of previous sample (Nwabueze *et aI*., 2008; Okafor and Ugwu, 2014).

Results and Discussions

Table 2: Sensory evaluation of cookies from blends of orange-fleshed sweet potato, soybean, and date fruit flours to produce cookies

Parameters	OSD1	OSD2	OSD3	OSD4	OSD5
Appearance	7.40^{a}±1.27	5.10^{c} ± 1.57	7.85^{a} ± 1.42	6.20^{b} ± 1.06	5.45^{c} ± 1.39
Taste	7.20^{a}±1.54	5.10^{c} ± 1.21	7.60^{a} ± 0.75	6.65^{b} ± 0.81	5.50^{c} ± 1.10
Texture	7.20^{a}±1.40	4.95^{c} ± 0.69	7.00^{a} ± 0.92	6.35^{b} ± 0.67	5.25^{c} ± 0.79
Flavor	7.30^{a}±1.30	4.70^{c} ± 0.92	6.55^{a} ± 0.99	5.60^{b} ± 0.99	5.70^{b} ± 0.92
General Acceptance	7.30^{a}±1.59	5.25^{c} ± 0.72	7.25^{a} ± 0.72	6.70^{b} ± 0.57	6.45^{b} ± 0.89

Key:OSD1= 100% wheat flour (Control); OSD2=80 Orange-fleshed sweet potatoes flour %, 15% Soybean flour, 5 % Date fruit flour, 0 % Wheat flour; OSD3= 70 % Orange-fleshed sweet potatoes flour, 20 % Soybean flour, 10% Date fruit flour, 0 % Wheat flour; OSD4 =60 % Orange-fleshed sweet potatoes flour, 25 % Soybean flour, 15% Date fruit flour. OSD5 = 50 % Orange-fleshed sweet potatoes flour, 30 % Soybean flour,20 % Date fruit flour; 0 % Wheat flour

The sensory evaluation of cookies made from blends of orange-fleshed sweet potato (OFSP), soybean, and date fruit flour shows significant differences in sensory parameters such as appearance, taste, texture, flavor, and general acceptance (table 2). The control (OSD1) using 100% wheat flour received high scores across all sensory

attributes. OSD3 (70% OFSP, 20% soybean, and 10% date fruit flour) also performed well, particularly in taste and general acceptance. However, blends with higher percentages of OFSP and soybean flour (OSD2, OSD4, and OSD5) scored lower in appearance and texture, which might be due to the higher fiber content and reduced gluten compared to wheat flour.

OSD3 showed the highest score for appearance (7.85), closely followed by OSD1 (7.40), indicating that the cookies with a moderate blend of OFSP, soybean, and date fruit flour are more visually appealing than other samples. The lower scores for OSD2 and OSD5 (5.10 and 5.45) may be attributed to the denser and less refined texture introduced by higher OFSP and soybean content, which can affect visual attractiveness (Okorie *et aI*., 2022).

Taste ratings were highest for OSD3 (7.60) and OSD1 (7.20), demonstrating that a moderate mixture of OFSP and soybean provides a balanced and pleasant flavor. The inclusion of date fruit likely enhances the natural sweetness of these blends without compromising taste. However, OSD2 and OSD5 had relatively lower taste scores, possibly due to a higher concentration of soybean, which might contribute to a more beany flavor (Idowu *et aI*., 2023).
The texture score followed a similar trend, with OSD1 and OSD3 showing the highest scores (7.20 and 7.00, respectively). This result indicates that the substitution of wheat flour with moderate levels of OFSP and soybean flour does not significantly impair the desired cookie texture. However, higher levels of OFSP and soybean flour (OSD2 and OSD5) contributed to a denser texture, leading to lower scores (4.95 and 5.25). Previous studies suggest that soybean and OFSP tend to absorb more moisture, resulting in a more compact texture (Ademola *et aI*., 2021).

The flavor profile also favored OSD3 (6.55) and OSD1 (7.30), suggesting that the sweet and nutty flavors introduced by the date fruit and soybean in the moderate blend (OSD3) were well-received by the sensory panel. OSD2, with lower flavor scores, may have had a more pronounced beany taste, which is typically less preferred by consumers (Akinyele *et aI*., 2020).

The overall acceptability was highest for OSD1 and OSD3 (7.30 and 7.25), indicating that both the control (100% wheat) and a balanced composite flour blend of OFSP, soybean, and date fruit offer favorable sensory attributes. OSD4 and OSD5 showed moderate acceptance but were slightly lower than the control due to their texture and flavor profiles.
In conclusion, blending orange-fleshed sweet potato, soybean, and date fruit flour is feasible for producing nutritious and sensory-acceptable cookies. Moderate blends such as OSD3 (70% OFSP, 20% soybean, and 10% date fruit flour) provide an optimal balance of taste, texture, and overall acceptance, making them a viable alternative to wheat-based cookies for healthier snacking options.

Conclusion

The sensory evaluation of cookies made from blends of orange-fleshed sweet potato, soybean, and date fruit flours indicates that these alternative ingredients can enhance the overall nutritional profile while maintaining acceptable sensory quality. Among the test samples, OSD3 (70% sweet potato, 20% soybean, 10% date flour) most closely matched the control in terms of taste, texture, and overall acceptability, demonstrating that gluten-free alternatives can be well-received by consumers. The incorporation of these functional ingredients—rich in fiber, protein, and essential nutrients—offers potential health benefits and supports the development of more nutritious, gluten-free bakery products.

Recommendations

Based on the findings, it is recommended that further research be conducted to optimize these flour blends for large-scale production. There is also significant potential for market development targeting gluten-free, nutrient-rich cookies for consumers with specific dietary needs, such as individuals with celiac disease or gluten sensitivities. Additionally, future studies should investigate the shelf-life stability of these flour blends and assess the economic viability of producing such innovative and nutritious baked products.

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