Egyptian Journal of Nutrition
Official journal of the Egyptian Nutrition Society
Print ISSN: 1687-1235
Online ISSN: 2090-2514
Vol. 39 (2): 23 – 35 (2024)
https://ejn.journals.ekb.eg/

NUTRITIONAL AND MICROBIAL EVALUATION OF COOKIES PRODUCED FROM CANARY MELON (*Cucumis melo)* SEED AND WHEAT FLOUR BLENDS

Oluwapamilerin Damola Fakile[1], Olorunfunmi Isimioluwa Solana[1] and Joel Eviano Okolosi[1]

[1]Department of Home Science and Hospitality Management, Faculty of Agricultural Management and Rural Development, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Nigeria

[1]Department of Home Science and Hospitality Management, Faculty of Agricultural Management and Rural Development, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Nigeria

[*]Corresponding Author: oluwapamilerin.yangomodou@oouagoiwoye.edu.ng

ABSTRACT

Cookies were produced from different flour blends of wheat and canary melon seed flour at 10-80% ratios to assess the suitability of canary melon seed flour in baking cookies of higher nutritional value. Cookies from 100% wheat flour served as the control. The functional, proximate, sensory and microbial qualities of the cookie's samples were investigated. The ash content ranged from 1.40 - 2.80%, fat (19.68 - 22.50%), crude fiber (0.60 - 3.50 %) and protein (5.00 - 12.05%). The functional properties of the flour blends varied as the flour blend substitutions increased. An increase was observed in the oil absorption capacity (0.88% - 1.30%), water absorption capacity (0.70 % - 1.55%), bulk density (0.82 - 1.06 g/cm^3), swelling index (2.64 % -1.69%), emulsion capacity (36.60 – 50.65 %). The result of sensory attributes of cookies appearance ranged from 5.42 - 7.30, taste (4.50 - 7.40), aroma (5.00 -7.20) and texture (0.95 - 7.20). The overall acceptability value ranged from 5.00 - 12.05. Result shows that acceptable cookies can be produced from composite substitute of 70:30 (W3CMF3). The result of microbial count showed that the total bacterial counts (TBCs) and fungal counts (TFCs) of the cookies samples were observed to increase during storage. TBCs and TFCs of cookies samples after 3 weeks of storaged range from 6.05 x 10^3 to 9.50 x 10^{3}cfu/g and 5.25 x 10^3 to 7.03 x 10^{3}cfu/g. The cookies had good shelf life and were within recommended safe limits.

Keywords: Wheat flour, Canary melon seed flour, Cookies, Nutritional assessments

Received: 25-2-2024 ***Accepted: 20-4-2024*** ***Published: 1-6-2024***

INTRODUCTION

Cookies are sweetened and convenient food product which are non-yeast baked, usually prepared from wheat flour and ingredients such as eggs, sugars, baking powder, shortenings and milk. Cookies are choice deserts used in various occasion such as weddings, birthdays and ceremonial occasions **(Olatunde *et al*., 2019)**. In cookie preparation, wheat a major ingredient used is a cereal cultivated world-wide, but imported by countries suffering from bad climatic conditions. A typical example of such country is Nigeria. The country is known to spend huge amount of money on wheat importation which has resulted in the urgent need to develop good substitute for wheat flour.

Previous research studies have shown that composite flours can be used in the production of nutritious and quality confectionaries. Composite flours can be used as alternative to wheat flours in making of confectionaries; thereby limiting total dependence on wheat flour for production of confectionaries. Research studies have also shown that wheat flour can be partially replaced up to about 50% with other food crops such as nuts, cereals and roots grown locally **(Ebabhamiegbebho *et al*., 2020; China *et al*., 2022).**

Canary melon (*Cucumis melo L*) belongs to the botanical family *Cucurbitaceae* **(Raji and Orelaja, 2014; Zeb, 2016).** Canary melon has roots, stem, leaf and can creep **(Ajuru and Okoli, 2013**). The vine of the plant can creep or trail, and it produces pretty yellow flowers in the spring. The melon's mature size is up to 2 feet tall, and 10 feet long **(Petkova and Antova, 2015).** The melon plant is native to central Asia including Japan and South Korea and its many cultivated varieties are widely grown in warm regions world-wide. Canary melons are beautiful bright yellow hybrid melons with pale green flesh which turns yellowish with a soft texture when ripe **(Warra and Sheshi, 2015).** Canary melons are also seeded and grown for its edible fruits. The seeds are flattened and may be cream or light yellow in colour **(Raji and Orelaja, 2014).**

Wheat flour is commonly used to make different types of baked snacks due to its gluten content. Its gluten content affords it the ability to form very good dough with elasticity; a feature not found in other flours **(Ubbor *et al*., 2022).** Unfortunately, wheat is not available in some parts of the world due to climatic change and vegetation hence this is responsible for the importation of wheat to affected parts to meet the huge demand of people for snacks, bread and other confectionaries. As a result, bakers face serious problems of increased production cost due to the importation of wheat which results to increase price of wheat flour and baked foods **(Ubbor *et al*., 2022).**

Today, canary melons are still valuable as food crops but unfortunately, they are more widely used for their ornamental values. Canary melons has not found much application in the food industry but is consumed in many homes across the globe. The fleshy portion is usually eaten fresh by itself for breakfast, lunch or dessert or as part of other dishes like soups, salads, smoothies and more **(Mallek Ayadi *et al*., 2018).** The seeds contain oil which show promising useful characteristics suitable for industrial and medicinal applications **(Warra** and **Sheshi, 2015; Selale *et al*., 2012).**

Canary melon has attracted increasing attention in recent times from scientists because of the good nutritional and health benefits of the seeds **(Ajuru and Okoli, 2013; Raji** and **Orelaja,**

2014). The seed is rich in protein which also has medicinal properties such as anti-inflammatory, anti-fungi, antibacterial and anti-diabetic properties **(Yangomodou *et al*., 2021).** Traditionally, canary melon have been used for various medicinal purposes in developing countries and obtained renewed use in Europe and United State. Canary melons are rich in fiber and antioxidant vitamin C which helps to keep the digestive tract of humans under check **(Raji and Orelaja, 2014).**

In this study, the use of wheat flour and canary flour composites in the making of cookies were evaluated as a way of alleviating the problems linked with the over-reliance on wheat flour for making confectionaries. The objective of this study was to evaluate the nutritional and microbial quality of cookies prepared from wheat and canary melon seed blends.

MATERIALS AND METHODS

Materials

Canary melon, wheat grains and other necessary ingredients such as sugar, margarine, butter, egg, baking powder and evaporated milk were purchased from Sabo Yaba market in Lagos, Nigeria.

Preparation of wheat and canary melon seed flours **Ubbor *et al*., (2022)** method was used in the production of wheat flour. Extraneous materials were removed from the wheat grains after which they were washed in sterile water and drained off using perforated plastic sieve. The wheat grains were thereafter dried in the oven at 60 °C for 8 h milled using blender and sieved using 250 µm mesh size to obtain fine wheat flour that was packaged in a transparent cellophane bag and stored at room temperature 25 °C until further use.

The flow chart for the processing of canary melon seed into flour is shown in Figure 1.The method described by **Dawi *et al*., (2022)** was used in the production of canary melon seed flour. Healthy canary melons were washed in sterile distilled water to remove dirt adhering to the surface. The melons were cut into halves and the seeds were removed. The seeds were dried in the oven at 60 °C for 8 h, after which they were milled using a blender. The resulting flour was sieved using a sieve with 0.5 mm pore size to obtain the flour. This was packaged in air tight containers and labeled until further use.

Formulation of flour blends

Wheat flour and canary melon seed flour blends were produced in different proportions as stated below.

Table 1. Formulations of Percentage Ratio of Wheat and Canary melon seed flour blends (%)

Sample code	Wheat	Canary melon seed
W0CMF0	100	00
W1CMF1	90	10
W2CMF2	80	20
W3CMF3	70	30
W4CMF4	60	40
W5CMF5	50	50
W6CMF6	40	60
W7CMF7	30	70
W8CMF8	20	80

Key:
W0CMF0- 100% Wheat flour (100:0 control)
W1CMF1 – 90 % Wheat flour: 10% canary melon seed flour (90:10)
W2CMF2 – 80 % Wheat flour: 20% canary melon seed flour (80:20)
W3CMF3 – 70 % Wheat flour: 30% canary melon seed flour (70:30)
W4CMF4 – 60 % Wheat flour: 40% canary melon seed flour (60:40)
W5CMF5 – 50 % Wheat flour: 50% canary melon seed flour (50:50)
W6CMF6 – 40 % Wheat flour: 60% canary melon seed flour (40:60)
W7CMF7 – 30 % Wheat flour: 70% canary melon seed flour (30:70)
W8CMF8 – 20 % Wheat flour: 80% canary melon seed flour (20:80)
Production of wheat-canary melon seed cookies

Ubbor *et al*., (2022) method was used in the preparation of cookies samples. All the food materials listed in Table 2 was used to prepare canary melon creamy cookies.

Table 2. Recipe Formation

Ingredient	Quantity (%)
Flour (different ratio’s)	100
Margarine	60
Sugar	50
Milk	10
Baking powder	1.25
Egg	7.50
Flouring agent	1.25
Salt	1.50

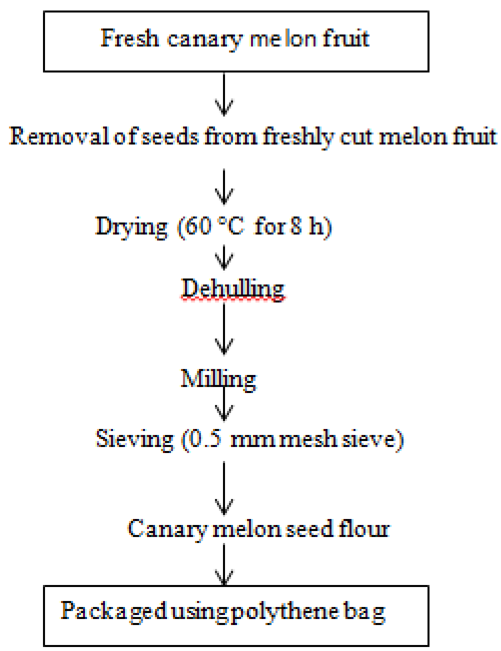

Figure 1. Production of canary melon seed flour
Source: Adopted method of Dawi *et al*., (2022)

Determination of functional properties of flours

Water absorption capacity, oil absorption capacity, emulsion capacity, bulk density, swelling index of the wheat and canary melon seed flour blends was determined using the method of **Onwuka, (2018).**

Determination of proximate composition of cookies

The moisture, ash, crude fibre, crude fat, protein and carbohydrate contents of the cookies were determined using the method of **Onwuka, (2018) and AOAC, (2000).**

Determination of physical properties of cookies

The weight, height and volume of the cookies produced were determined using the methods described by **Nwosu *et al*., (2014).**

Sensory evaluation of cookies

Sensory evaluation was carried out on the cookies samples with 100% wheat flour cookies as control. A sensory panel consisting of twenty five (25) semi-trained panelists of staff and students selected from the Department Home Science and Hospitality Management, Olabisi Onabanjo University, Ago-iwoye assessed the cookies samples. The 9 point hedonic scale was used. The texture, taste, appearance, aroma and overall acceptability were scored in a 9 point hedonic scale for each cookies sample.

Microbiological analysis of wheat-canary melon seed flour blend cookies

The cookies samples were analyzed for bacterial and fungal counts using spread plate method described by **Mat Nwawi *et al*., (2016)** and **Ike *et al*., (2020)**. Tenfold serial dilution of cookies samples were carried out using sterile peptone water. The cookies samples were mashed and packaged in airtight container, stored at room temperature (37 °C) and analyzed at weekly intervals of 3 weeks. For the analysis one (1 g) gram of each sample was mashed and aseptically transferred into a sterile test tube containing nine milliliter (9 mL) of sterile peptone water. The resultant sample solutions were stirred with sterile glass rod and shaken vigorously to allow proper disengagement of microorganisms 10^1 dilution. Serial dilutions of the homogenates were continued and made up to 10^5 dilutions. For the purpose of this study, 10^2 and 10^5 dilutions were used. 0.1 ml of the dilutions was spread on plate count agar and sabouraud dextrose agar. Spread plate method of **Ike *et al*., (2020)** were used to enumerate bacteria and fungi in the samples and each dilution was plated in replicates using plate count agar and sabouraud dextrose agar (SDA). The plates were incubated at 37 °C for 72 hours for mean bacterial counts and 25 °C for 120 hours for mean fungal counts.

Statistical Analysis

One-way analysis of variance was carried out using SPSS version 23.0. Duncan multiple range test (DMRT) was used to separate the treatment means.

RESULTS AND DISCUSSION

Functional properties of wheat and canary melon seed flour

Table 3 presents the results of the functional properties of wheat and canary melon seed flour ratios

The oil absorption capacity (OAC) of the wheat-canary melon seed flour blends increased significantly ($p<0.05$) from 0.88 % - 1.30 % for the control sample (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). OAC increased as canary melon seed flour increased. **Adeleke and Odedeji (2010)** reported the same on wheat and sweet potato flour blends. **Dawi *et al*., (2022)** also reported high OAC for bean fruit pulp flour and wheat blends. OAC acts as an enhancer of flavor. The higher OAC values obtained indicates that foods with higher levels of canary melon flour would retain flavor and also give better mouth feels.

The water absorption capacity (WAC) increased significantly ($p<0.05$) from 0.70 % -1.55 % for the control sample (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). The higher values obtained shows that canary melon seed flour has higher WAC than wheat flour. This can probably be as a result of loose structure of starch polymers in wheat **(Dawi *et al*., 2022)** while low values shows the firmness of the structure **(Hussein *et al*., 2010).**

The bulk density (BD) increased significantly ($p<0.05$) from 0.82 - 1.06 g/cm^3 for the control sample (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). This result corresponds with the report (0.80 – 092 g/cm^3) of Akoja *et al*., (2017) for kokoro a maize based snack. **Odusanya *et al*., (2023)** also reported 0.62 - 0.72 g/cm^3 for wheat flour substituted with pigeon pea and orange peel. Bulk density of the flours helped to determine their storage requirement.

Significant difference in the swelling index (SI) of the two flour blends used in this study was observed. Values obtained were within the range of 1.69% (W0CMF0- 100% whole wheat flour) to 2.64 % (W8CMF8). Substitution of wheat with canary melon flour increased the SI of the flour blends. This result compares well with that of **Odusanya *et al*., (2023)** who reported 11.96 % – 12.66 % for wheat flour substituted with pigeon pea and orange peel

The emulsion capacity (EC) of the flour blends increased significantly ($p<0.05$) from 36.60 – 50.65 % for the control sample (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). The EC values increased as the wheat flour is substituted with canary melon seed flour. This result is in agreement with the report of **Chandra *et al*., (2015)** who reported 38.38 % - 48.65 % for wheat flour substituted with rice flour.

Table 3: Functional properties of wheat and canary melon seed flour blends

Sample	OAC %	WAC %	EC %	BD (g/cm^3)	SI %
W0CMF0	$0.88^{i} \pm 0.00$	$0.70^{i} \pm 0.00$	$36.60^{i} \pm 0.00$	$0.82^{f} \pm 0.00$	$2.64^{a} \pm 0.00$
W1CMF1	$0.92^{h} \pm 0.01$	$1.03^{e} \pm 0.09$	$38.45^{h} \pm 0.11$	$0.85^{e} \pm 0.03$	$2.56^{b} \pm 0.03$
W2CMF2	$0.99^{g} \pm 0.01$	$1.12^{d} \pm 0.00$	$40.87^{g} \pm 0.04$	$0.89^{d} \pm 0.00$	$2.32^{c} \pm 0.01$
W3CMF3	$1.03^{f} \pm 0.01$	$1.17^{d} \pm 0.02$	$41.65^{f} \pm 0.12$	$0.89^{d} \pm 0.01$	$2.17^{d} \pm 0.02$
W4CMF4	$1.06^{e} \pm 0.00$	$1.24^{cd} \pm 0.00$	$43.88^{e} \pm 0.00$	$0.92^{c} \pm 0.01$	$1.88^{e} \pm 0.05$
W5CMF5	$1.09^{d} \pm 0.00$	$1.32^{bc} \pm 0.00$	$46.23^{d} \pm 0.10$	$0.94^{b} \pm 0.00$	$1.84^{f} \pm 0.00$
W6CMF6	$1.12^{c} \pm 0.00$	$1.45^{ab} \pm 0.00$	$48.22^{c} \pm 0.04$	$0.98^{b} \pm 0.04$	$1.76^{g} \pm 0.03$
W7CMF7	$1.25^{b} \pm 0.00$	$1.50^{a} \pm 0.00$	$49.99^{b} \pm 0.00$	$0.98^{a} \pm 0.02$	$1.70^{h} \pm 0.00$
W8CMF8	$1.30^{a} \pm 0.00$	$1.55^{a} \pm 0.00$	$50.65^{a} \pm 0.06$	$1.06^{a} \pm 0.02$	$1.69^{i} \pm 0.02$

Alphabets a-i: Means ± standard deviation of duplicate determination. Means bearing the same superscripts within the same column are not significantly different ($p<0.05$).

QAC= Oil absorption capacity, WAC = Water absorption capacity, BD= Bulk density, SI = Swelling index, EC = Emulsion capacity.

Proximate composition of cookies

Table 4 presents the proximate composition results. The moisture content of the cookies ranged from 9.10 – 11.50 % for samples W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80) and W0CMF0-(100% wheat flour. The moisture content of the cookies samples decreased with increased proportion of canary melon seed flour indicating the cookies will have longer shelf-life. **Deedam *et al*., (2020) and Odusanya *et al*., (2023)** reported 12% as adequate moisture values for confectionaries. This means that cookies produced samples with less than 12% moisture content can be stored at room temperature 25°C and be less affected by fungal and microbial infections (Ubbor *et a*l., 2022).

The ash content of the cookies samples significantly ($p<0.05$) increased from 1.40-2.80% for the (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80) respectively. Canary melon seed flour enhanced the ash content of the cookies. **Olatunde *et al*., (2019)** reported similar result for cakes. Ash content of food gives the sum total of mineral in food.

The fat content of the cookies samples significantly ($p<0.05$) increased from 19.68 to 22.50% for cookies samples (W0CMF0- 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). Canary melon seed improved the fat content of wheat flour. **Obasi and Zakka, (2023)** reported increased fat for bread produced from wheat and soybeans.

The crude fibre content increased significantly from 0.60 % to 3.50 % with the substitution of wheat flour with canary melon seed flour indicating that canary melon seed has high fibre content than wheat. This result correlates with the report of **Uzo-Peters and Ola, (2020)** who obtained higher fibre values (2.9 % - 11.55 %) for sosa a local snack. The high fibre content of the cookies samples will help prevent common digestive issues such as constipation in human.

The protein content of the cookies ranged from 5.00 to 12.05% for cookies samples (W0CMF0 - 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). The protein content of the cookies increased with the substitution of canary melon seed flour indicating that canary melon seed contains higher protein than wheat. This result is similar to that of **Deedam *et al*., (2020)** for chin-chin (5.53 % to 7.95 %) prepared from wheat substituted with African walnut.

The carbohydrate content of the cookies decreased from 65.00 to 54.88 for the control cookies sample (W0CMF0 - 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). This indicates that canary melon seed flour is not a rich source of carbohydrate. **Deedam *et al*., (2020)** reported a carbohydrate decrease in chin-chin produced from wheat and African walnut.

The energy value of the cookies samples significantly increased from 435.00 to 484.66 kcal/100g for the control cookies sample (W0CMF0 - 100% whole wheat flour) and W8CMF8 (20 % Wheat flour and 80% canary melon seed flour (20:80). This may be due to the high fat and protein content of the cookies samples. This result compares well with that of **Ubbor *et a*l., (2022)** who reported 432.80 to 453.05kcal/100g for cake produced from wheat flour supplemented with banana.

Table 4: Proximate composition of wheat and canary melon seed flour blend cookies

Sample	Moisture	Ash	Fat	Fibre	Protein	Carbohydrate	Energy (Kcal/100g)
W0CMF0	$11.50^{a} \pm 0.00$	$1.40^{h} \pm 0.00$	$19.68^{h} \pm 0.06$	$0.60^{i} \pm 0.06$	$5.00^{i} \pm 0.00$	$65.00^{a} \pm 0.30$	$435.00^{i} \pm 0.40$
W1CMF1	$11.30^{b} \pm 0.11$	$1.45^{gh} \pm 0.02$	$19.75^{g} \pm 0.06$	$0.95^{h} \pm 0.06$	$5.15^{h} \pm 0.12$	$62.30^{b} \pm 0.00$	$439.20^{h} \pm 1.20$
W2CMF2	$11.05^{c} \pm 0.01$	$1.87^{g} \pm 0.02$	$19.80^{f} \pm 0.12$	$1.35^{g} \pm 0.00$	$7.76^{g} \pm 0.00$	$60.50^{c} \pm 0.22$	$442..10^{b} \pm 0.42$
W3CMF3	$10.40^{cd} \pm 0.12$	$1.97^{f} \pm 0.02$	$21.05^{e} \pm 0.12$	$2.00^{f} \pm 0.06$	$7.67^{f} \pm 0.12$	$59.78^{d} \pm 0.00$	$449.78^{f} \pm 0.00$
W4CMF4	$10.20^{d} \pm 0.00$	$2.24^{e} \pm 0.00$	$21.28^{f} \pm 0.00$	$2.50^{e} \pm 0.06$	$8.40^{e} \pm 0.06$	$59.40^{e} \pm 0.22$	$451.20^{e} \pm 0.52$
W5CMF5	$10.10^{e} \pm 0.00$	$2.40^{d} \pm 0.00$	$21.35^{g} \pm 0.00$	$2..94^{d} \pm 0.00$	$9.70^{d} \pm 0.02$	$58.50^{f} \pm 0.30$	$463.50^{d} \pm 0.42$
W6CMF6	$9.90^{f} \pm 0.00$	$2.55^{c} \pm 0.00$	$21.62^{h} \pm 0.12$	$3.18^{c} \pm 0.06$	$10.72^{c} \pm 0.06$	$56.56^{g} \pm 0.35$	$465.46^{c} \pm 0.12$
W7CMF7	$9.65^{f} \pm 0.10$	$2.60^{a} \pm 0.03$	$22.20^{b} \pm 0.00$	$3.38^{b} \pm 0.00$	$11.86^{b} \pm 0.06$	$55.43^{h} \pm 0.06$	$475.31^{h} \pm 0.74$
W8CMF8	$9.10^{g} \pm 0.00$	$2.80^{a} \pm 0.03$	$22.50^{a} \pm 0.06$	$3.50^{g} \pm 0.06$	$12.05^{a} \pm 0.00$	$54.88^{i} \pm 0.12$	$484.66^{a} \pm 0.06$

Means bearing the same superscripts within the same column are not significantly different ($p<0.05$).

Physical properties of cookies

Table 5 presents the results for the physical properties of cookies samples. The weight of the cookies samples ranged from 83.40 to 85.37g for the control cookies sample (W0CMF0 - 100% whole wheat flour) and W7CMF7 (30 % wheat flour and 70% canary melon seed flour (30:70). Cookies produced from all the flour blends had higher weights compared to the control (83.40g).This may be due to the high fat content of the cookies samples compared to the control sample. The result is similar to 83.10 - 84.78g reported by **Ubbor *et a*l., (2022)** for wheat banana cake.

The height of cookies ranged from 4.50 cm to 4.00 cm for cookies samples. The cookies sample W0CMF0 (100% whole wheat flour, control) had 4.50 cm and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80) had 4.00 cm value. The height of cookies samples reduced with increase in the canary melon seed flour. **Ikpeme-Emmanuel *et al*., (2012)** reported reduced height for cake baked from wheat and beniseed flours.

The cookies volume decreased from 299.78 cm^3 to 200.10 cm^3.The cookies sample W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80) had the least volume value (200.10 cm^3) while the control sample had the highest value (299.78 cm^3). **Ubbor *et a*l., (2022)** reported similar observation for cake produced from wheat –banana flours.

Table 5: Physical properties of wheat and canary melon seed flour blend cookies

Sample	Weight (g)	Height (cm)	Volume (cm^3)
W0CMF0	$83.40^{f} \pm 0.04$	$4.50^{a} \pm 0.00$	$299.78^{a} \pm 2.06$
W1CMF1	$83.90^{ef} \pm 0.08$	$4.45^{ab} \pm 0.02$	$290.55^{b} \pm 3.06$
W2CMF2	$84.05^{de} \pm 0.11$	$4.37^{abc} \pm 0.14$	$285.40^{c} \pm 2.16$
W3CMF3	$84.23^{cd} \pm 0.12$	$4.25^{abc} \pm 0.06$	$273.21^{c} \pm 2.22$
W4CMF4	$84.35^{bc} \pm 0.04$	$4.24^{bcd} \pm 0.06$	$260.28^{d} \pm 1.40$
W5CMF5	$84.50^{ab} \pm 0.07$	$4.20^{cd} \pm 0.00$	$250.55^{e} \pm 1.40$
W6CMF6	$84.90^{ab} \pm 0.04$	$4.15^{cd} \pm 0.00$	$243.32^{f} \pm 1.22$
W7CMF7	$85.25^{a} \pm 0.06$	$4.10^{d} \pm 0.01$	$221.20^{g} \pm 2.43$
W8CMF8	$85.37^{a} \pm 0.07$	$4.00^{e} \pm 0.01$	$200.10^{h} \pm 3.12$

Means bearing the same superscripts within the same column are not significantly different ($p<0.05$).

Sensory evaluation of cookies

Shown in Figure 2 are some examples of the cookies produced from wheat and canary melon seed flour blends. The scores for taste of the cookies samples ranged from 7.40 to 4.50 (W0CMF0 - 100% whole wheat flour) and W8CMF8 (20 % wheat flour and 80% canary melon seed flour (20:80). In terms of appearance, aroma, texture and general acceptability, the control cookies sample (W0CMF0 - 100% whole wheat) was most preferred and followed by cookies samples produced from 30 % canary melon seed flour. This indicates that substitution of canary melon seed flour up to 30 % would give good quality cookies acceptable and comparable to 100 % wheat. Similar result was reported by **Peter-Ikechukwu *et al*., (2017)** on cookies prepared from wheat and date palm fruit.

Table 6: Sensory properties of wheat and canary melon seed flour blends cookies

Sample code	Taste	Appearance	Aroma	Texture	General Acceptability
W0CMF0	$7.40^{a} \pm 0.00$	$7.30^{h} \pm 0.00$	$7.50^{h} \pm 0.06$	$7.20^{i} \pm 0.06$	$5.00^{i} \pm 0.00$
W1CMF1	$7.30^{b} \pm 0.11$	$7.23^{gh} \pm 0.02$	$7.35^{g} \pm 0.06$	$0.95^{h} \pm 0.06$	$5.15^{h} \pm 0.12$
W2CMF2	$6.85^{c} \pm 0.01$	$7.00^{g} \pm 0.02$	$7.10^{f} \pm 0.12$	$1.35^{g} \pm 0.00$	$7.76^{g} \pm 0.00$
W3CMF3	$6.40^{cd} \pm 0.12$	$6.73^{f} \pm 0.02$	$6.66^{e} \pm 0.12$	$2.00^{f} \pm 0.06$	$7.67^{f} \pm 0.12$
W4CMF4	$5.25^{d} \pm 0.00$	$6.22^{e} \pm 0.00$	$6.48^{f} \pm 0.00$	$2.50^{e} \pm 0.06$	$8.40^{e} \pm 0.06$
W5CMF5	$5.13^{e} \pm 0.00$	$6.10^{d} \pm 0.00$	$6.35^{g} \pm 0.00$	$2..94^{d} \pm 0.00$	$9.70^{d} \pm 0.02$
W6CMF6	$5.03^{f} \pm 0.00$	$5.73^{c} \pm 0.00$	$5.28^{h} \pm 0.12$	$3.18^{c} \pm 0.06$	$10.72^{c} \pm 0.06$
W7CMF7	$4.75^{f} \pm 0.10$	$5.60^{a} \pm 0.03$	$5.20^{b} \pm 0.00$	$3.38^{b} \pm 0.00$	$11.86^{b} \pm 0.06$
W8CMF8	$4.50^{g} \pm 0.00$	$5.42^{a} \pm 0.03$	$5.00^{a} \pm 0.06$	$3.50^{g} \pm 0.06$	$12.05^{a} \pm 0.00$

Means bearing the same superscripts within the same column are not significantly different ($p<0.05$).

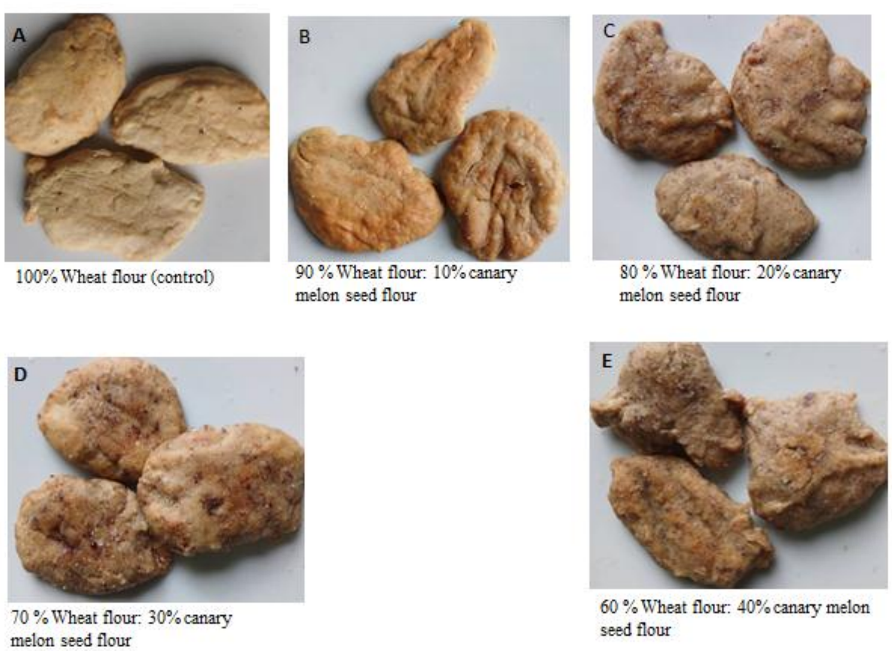

Figure 2. **Examples of wheat and canary melon seed flour blend cookies.**

Microbial evaluation of wheat and canary melon seed flour blend cookies

Total bacterial counts of cookies

The total bacterial counts (TBCs) of cookies produced from wheat canary melon seed flour blends are presented in Table 7. TBCs of the cookies samples at week 0 recorded no growth while at week 1, all the samples had counts of 1.20 x 10^2 cfu/g. At week 2 and 3, there was an increase in mould count of cookies samples with values ranging from 4.60 x 10^2 to 9.05 x 10^2cfu/g and 6.05 x 10^3 to 9.50 x 10^3cfu/g.

Cookies samples substituted with canary melon seed flour had higher TBCs than the control sample. This is as a result of the incorporation of canary melon seed flour which may have supported or encouraged microbial action. The high TBCs in cookies samples substituted with canary melon seed flour may also be due to the increase in protein content of the cookies samples substituted with canary melon seed flour. This finding is in line with that **Deedam *et al*., (2020)** who reported increased in the level of microbial contamination to be due to increased level of proteins and fats in chin-chin produced from wheat and African walnut. According to **Deedam *et al*., (2020)** microbes associated with the spoilage of baked foods grow faster in highly nutritious medium. Despite the increase in total bacterial counts, these counts were within the acceptable microbial limit of 10^4 to 10^6cfu/g for ready to eat food products.

Total fungal counts of cookies

Total fungal counts (TFCs) of the cookies samples at week 0 recorded no growth. At week 1, all the samples had TFCs ranging from no growth colonies in control sample to 4.40 x 10^2 in cookies substituted with 80% canary melon seed flour (W8CMF8). At week 2 and 3 there was an increase in the TFCs with values ranging from 3.99 x 10^2 to 6.30 x 10^2cfu/g and 5.25 x 10^3 to 7.03 x 10^3cfu/g. The TFCs of the cookies samples increased as substitution levels with African walnut flour increased. This increase in TFCs of the cookies samples can be attributed to an increase in protein content of the cookies samples as substitution with canary melon seed flour increased. The TFCs of the cookies samples after storage for a period of 3 weeks is still within the acceptable statutory limit of $<10^4$ recommended for ready to eat foods **(Deedam *et al*., (2020)** suggesting that the cookies samples prepared at all levels of canary melon seed flour substitution has good keeping quality up to a period of 3 weeks.

Table 7: Total bacterial and fungal counts (cfu/g) of wheat and canary melon seed flour blend cookies during storage.

	Bacteria				**Fungi**			
Sample code	**Storage period (Weeks)**				**Storage period (Weeks)**			
	0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
W0CMF0	No growth colonies	1.20 x 10^2	4.60 x 10^2	6.05 x 10^3	No growth colonies	No growth colonies	3.99 x 10^2	6.65 x 10^3
W1CMF1	No growth colonies	1.20 x 10^2	4.51 x 10^2	7.30 x 10^3	No growth colonies	3.70 x 10^2	4.86 x 10^2	6.65 x 10^3
W2CMF2	No growth colonies	1.20 x 10^2	4.40 x 10^2	7.05 x 10^3	No growth colonies	3.50 x 10^2	4.80 x 10^2	6.45 x 10^3
W3CMF3	No growth colonies	1.20 x 10^2	5.20 x 10^2	7.25 x 10^3	No growth colonies	3.55 x 10^2	4.40 x 10^2	5.25 x 10^3
W4CMF4	No	1.20 x 10^2	5.10 x 10^2	7.45 x 10^3	No	3.60 x 10^2	4.40 x 10^2	5.25 x 10^3

	growth colonies				growth colonies			
W5CMF5	No growth colonies	1.20×10^2	6.10×10^2	8.05×10^3	No growth colonies	4.40×10^2	5.20×10^2	6.14×10^3
W6CMF6	No growth colonies	1.20×10^2	7.20×10^2	8.55×10^3	No growth colonies	4.20×10^2	5.20×10^2	$6. 14 \times 10^3$
W7CMF7	No growth colonies	1.20×10^2	8.00×10^2	9.00×10^3	No growth colonies	4.20×10^2	6.30×10^2	7.00×10^3
W8CMF8	No growth colonies	1.20×10^2	9.05×10^2	9.50×10^3	No growth colonies	4.40×10^2	6.00×10^2	7.03×10^3

CONCLUSION

This study shows that good and acceptable cookies could be produced with wheat and canary melon seed flour blends. Results obtained in this study showed that the use of canary melon seed flour enhanced all the parameters investigated. However, carbohydrate and moisture content in cookies samples decreased with substitution of canary melon seed flour. The cookies samples also had increased crude fiber and ash indicating the increase in dietary fiber. All these qualities make canary melon seed flour a functional food ingredient and a good substitute for wheat.

REFERENCES

Adeleke, R. O. and Odedeji, J. O. (2010). Functional properties of wheat and sweet potato flour blends. *Pakistan Journal of Nutrition*, *9*(6), 535-538.

Ajuru, M. G. and Okoli, B.E.(2013). The morphological characterization of the melon species in the family *Cucurbitaceae Juss* and their utilization in Nigeria. *Int. J. Modern Botany*, 3(2): 15-19.H.

Akoja, S. S., Adebowale, O. J., Makanjuola, O. M. and Salaam (2017). Functional properties, nutritional and sensory qualities of maize-based snack (kokoro) supplemented with protein hydrolysate prepared from pigeon pea (*Cajanus Cajan*) seed. *Journal of culinary science & technology*, 15(4), 306-319.

AOAC 2000. Official Methods of Analysis (7th Ed.). Association of Official Analytical Chemists, Washington, DC, pp. 516 -697.

Chandra, S., Singh, S. and Kumari, D. (2015). Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits. *Journal of food science and technology*, 52, 3681-3688.

China, M. A. H., Amadi, G. A. and Ujong, A. E. (2022). Functional and pasting properties of wheat and cooking banana flour blends and their utilization in cookies production. *Research Journal of Food Science and Nutrition*, *7*(2), 59-67.

Dawi, A. W., Okpo, N. O., Alalade, O. M. and Tahir, Z. H. (2022). Proximate, Functional and Sensory Evaluation of Cake Produced from Composite Mixture of African Locust Bean Fruit Pulp (*Parkia Biglobosa*) Flour and Wheat Flour. Dutse *Journal of Pure and Applied Sciences* (DUJOPAS), 8(2) 245-255

Deedam, N. J., China, M. A. and Wachukwu, H. I. (2020). Proximate composition, sensory properties and microbial quality of chin-chin developed from wheat and African walnut flour blends for household food security. *European Journal of Nutrition & Food Safety*, *12*(8), 45-53.

Ebabhamiegbebho, P. A., Abel, E. S. and Willie, S. T. (2020). Composition and sensory quality of wheat-banana flour blend bread. *Trends Sci Technol J*, *5*(2), 529-32.

Hussein, A. M., Salah, Z. A. and Hegazy, N. A. (2010). Physicochemical, sensory and functional properties of wheat-doum fruit flour composite cakes. *Polish journal of food and nutrition sciences*, 60(3).

Ike, C. C., Emeka-Ike, P. C. and Ogwuegbu, H. O. (2020). Sensory properties, physical and microbiological studies of pumpkin seed (*Cucurbita pepo*) blended cakes. *GSC Biological and Pharmaceutical Sciences*, 12(3), 073-081.

Ikpeme-Emmanuel, C. A., Ekpeyoung, I. O. and Igile, G. O. (2012). Chemical and protein quality of Soybean (*Glycine max*) and Tigernut (*Cyperus esculentus*) based weaning food. *Journal of Food Research*, *1*(2), 246.

Mallek-Ayadi S, Bahloul, N and Kechaou N. (2018). Chemical composition and bioactive compounds of *Cucumis melo L.* seeds: Potential source for new trends of plant oils. *Process Safety and Environmental Protection*, 113: 68-77.

Mat Nawawi, N. S., Abdullah, N., Noor, Z. M. and Bujang, A. (2016). Microbiological quality of chocolate cake at retail outlet storage in the perspective of Halalan-Toyyiban. *Journal of Applied Environmental and Biological Sciences*, *6*, 59-63.

Obasi, B. C. and Zakka, R. (2023). Evaluation of proximate composition, physical and sensory properties of soybean supplemented wheat bread. *World Journal of Advanced Research and Reviews*, 18(1), 907-914.

Odusanya, M. D., Omosuli, S. V., Gbadamosi, O. A. and Ajagunna, A. O. (2023). Physicochemical properties of flour produced from wheat, pigeon-pea and orange fleshed sweet potato flour blends and their bread making potential. *International Research Journal of Modernization in Engineering Technology and Science,* 5(4), 4643-4648.

Olatunde, S. J., Ajayi, O. M., Ogunlakin, G. O. and Ajala, A. S. (2019). Nutritional and sensory properties of cake made from blends of pigeon pea, sweet potato and wheat flours. *Food Research*, *3*(5), 456-462.

Onwuka, G. I. (2005). Food analysis and instrumentation: theory and practice. Napthali Prints Lagos, Nigeria. 10-20

Petkova, Z. and Antova, G. (2015). Proximate composition of seeds and seed oils from melon (Cucumismelo L.) cultivated in Bulgaria. Cogent Food & Agriculture, 1(1): 1018779.

Raji, O. H. and Orelaja, O. T. (2014). Nutritional composition and oil characteristics of golden melon (*Cucumis melo*) seeds. *Food Science and Quality Management*, *27*, 18-21.

Şelale, H., Sıgva, H. O., Celik, I., Doganlar, S.and Frary, A. (2012). Water-soluble antioxidant potential of melon lines grown in Turkey. *International Journal of Food Properties*, *15*(1), 145-156.

Ubbor, S. C., Ezeocha, V. C., Arukwe, D. C., Ekeh, J. I., Iguh, B. N. and Jackson, A. S. (2022). Production and quality evaluation of cake from wheat and red banana flour blends. Science *World Journal*, 17(3), 413-420.

Uzo-Peters, P. I. and Ola, S. T. (2020). Proximate composition and functional properties of composite sorghum-okara flour and sensory evaluation of local snack product (sosa). *Agrosearch*, 20(1), 158-167.

Warra, A. A, Sheshi, F., Ayurbami, H.S. and Abubakar, A. (2015). Physico-chemical, GC-MS analysis and cold saponification of canary melon (*Cucumis melo*) seed oil. *Trends in Industrial Biotechnology Research*, 1(1): 10-17