Original Article

Proximate and Sensory Properties of *Dioscorea bulbifera* Composite Flour Made Cookies and Cake

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Submission Date: 13-06-2021; Revision Date: 05-07-2021; Accepted Date: 09-08-2021

ABSTRACT

Dioscorea bulbifera is a traditional wild tuber belongs to family Dioscoreaceae. It is not only rich in nutrients but also possesses medicinal properties. In this study an attempt has been made to produce cookies and cake from combination of wheat and *Dioscorea bulbifera* flour. *Dioscorea bulbifera* flour was incorporated with wheat flour in ratio of 25%, 50% and 75%. Composite flour made cookies and cake were examined for acceptability on the basis of biochemical and sensory parameters. Result of the study revealed that moisture, ash and fiber content gradually increases with increase in incorporation level of *Dioscorea bulbifera* flour (Dbf) with wheat flour at the same time as fat, carbohydrate and protein content steadily decreased. According to panelist 50% substituted cake and cookies received highest score for all the attributes. But all cookies and cake were not only obtained good score of overall acceptability but also possessed appreciable amount of nutrients.

Key words: Cake, Cookies, Composite flour, Sensory evaluation.

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INTRODUCTION

Cake and cookies are inexpensive suitable ready to eat food for all age groups in many countries. Wheat flour is used as main ingredient for cake and cookies production along with other ingredients such as sweeteners (sugar), leavening agents, milk, flavors, and butter. But in the last years, there is an increasing research interest in potential of composite flour in snacks preparation. Addition of locally available cereals, pulses and tuber flours with refined wheat flour enhances the quality of refined wheat flour. *Dioscorea bulbifera* is a traditional wild tuber belongs to family Dioscoreaceae. It is being consumed as staple food by rural and tribal people. Available literature reported that *Dioscorea bulbifera* is a good source of nutrients with appreciable levels of minerals[1,2] and has good quality of protein with 17 amino-acids.[3] The main use of *Dioscorea bulbifera* involves its tuber can be prepared and processed into edible food by boiling, frying or roasting or eaten as mixed with other vegetables.[4-6] Previous studies have shown the incorporation of *Dioscorea bulbifera* flour (Dbf) for the making of various products.[7] Prepared bread from wheat flour substituted with 25%, was found to be suitable while more than 25% substitution were not acceptable for this purpose. Composite flours containing blanched fermented sun dried aerial yam (AY) and Cassava flour(CS) in different ratio(AY_{100}, AY_{80} CS_{20}, AY_{60} CS_{40}, AY_{40} CS_{60} and AY_{20} CS_{80}) were also used to make paste. On the basis of sensory characteristics, out of the above different ratio, the 60-80% aerial yam incorporate composite flour found to be more suitable for the paste.[8] Aerial yam flour at different levels (10%, 20%, 30%, 40%, 50% up to 100%) with wheat flour were used for biscuit production. Biscuits made from 10% to 50% aerial yam substituted wheat flour were found to be acceptable while more than 50% substitution were not appreciable by panelists.[9]

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DOI: 10.5530/ajbls.2021.10.63

Similarly cookies are prepared from composite flour of aerial yam and wheat flour. But 50% aerial yam substituted cookies was found to be most conventional one by panelist in terms of colour, taste, aroma and overall acceptance.[10]

Keeping the above literature and review in sense in the present study an attempt has been made to prepare cake and cookies from the composite flour of locally Available *Dioscorea bulbifera* found in Sundargarh district of Odisha along with its proximate and sensory properties analysis.

MATERIALS AND METHODS

Plant material

Underground tuber of *Dioscorea bulbifera* were collected from different villages of Sundargarh district in the month of December 2020.

Sample preparation

Underground *Dioscorea bulbifera* tuber were cleaned, peeled and sliced about 1-2 mm using slicer. Thin slice tuber was boiled until foam formation. Then it was left under tap water until bitterness was not removed. After removal of bitterness tuber were dried in hot air oven at 80^0C until constant weight was obtained. Then powder was made by grinder and sieved through 1mm sieve. Powder sample was then used for cookies and cake preparation (Figure 1).

Determination of functional parameters

Bulk density

The gravimetric method[11] was used for the determination of bulk density of flour samples. Both loose volume and packed volume were recorded. 10gm flour sample was taken in a 25 ml of measuring cylinder and volume of this recorded as loose volume. Cylinder was tapped on a laboratory bench repeatedly until constant volume was observed, which was recorded as packed volume. The ratio of sample weight to the volume of sample before and after tapping was mentioned as loose bulk density (LBD) and packed bulk density (PBD).

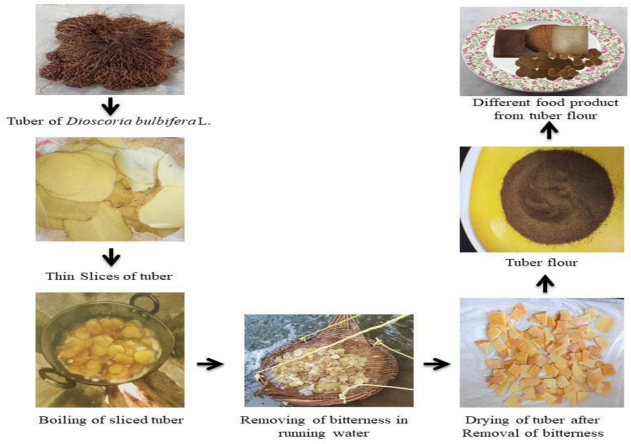

Figure 1: Different steps of Preparation of cookies and cake from *D. bulbifera* plant.

Water and Oil absorption capacity

Flour samples were analyzed for water and oil absorption capacity following the standard method.[12] A weight of (10%w/w) of the sample was thoroughly mixed with water/ oil using warring mixer for 30s. After mixing at room temperature it was allowed to stand for 30min then centrifuged at 5000rpm for 30 min. Supernatant was directly read from the graduated centrifuge tube. Volume of water/oil absorbed by flours was converted to weight by multiplication of density of water (1gm/ml) and soyabean oil (0.924g/ml). The water and oil absorption capacities (WAC/OAC) were expressed in grams of water/oil absorbed per gram of flour sample.

Emulsion activity

Emulsion activity of the flour sample was carried out following the standard method with slight modification.[11] At room temperature 2gm of flour sample was blended with 25ml of distill water for 30s using warring blender at 1600rpm. 25ml soy oil was added to this gradually after complete dispersion and it was blended again for 30s. The blend was centrifuged for 5min at 1600rpm. After centrifugation separated volume of oil was read directly from the tube. Emulsion activity was calculated as the ratio of height of emulsion to the total height of flour and was expressed as a percentage.

Cake and cookies making process

Cake and cookies were prepared from composite flours of 25%, 50% and 75% substituted dbf to wheat flour. 100% refined wheat flour was taken as control. Ingredients used for cake making were dry milk powder, refined oil, sugar, leavening agent and composite flour. Cookies dough was made from butter, leavening agent, sugar and composite flour**.** Small round shape cookies were prepared from dough and backed in OTG for 20 min. Whereas cakes were made in baking oven. (Figure 2)

Proximate composition

Ash and fat contents were determined using muffle furnace and Soxhlet apparatus following the standard method.[13] The crude fiber content was determined by dilute acid and alkali hydrolysis.[13] Total carbohydrate was estimated using Anthrone reagent method.[14]

Protein content of both the raw and boiled tuber samples was estimated following the standard method.[15]

Sensory evalution

Cake and cookies made from *D. bulbifera* flour were evaluated for Sensory parameters appearance, flavor, taste, texture and overall acceptability by 30 untrained panelists. The evaluation process was based on nine-point hedonic scale where 1 stand for dislike extremely and 9 for like extremely. Unsalted cracker and distill water were provided to the panelist for refresh their palate after tasting each sample.

Statistical Analysis

Statistical analysis of variance (ANOVA) was subjected within the treatments for obtained data of each parameters.

RESULTS

Functional property of Flours

Functional properties of flours are estimated to assume the behavior of flour constituents in products. Functional properties including loose bulk density, packed bulk density, water absorption capacity, oil absorption capacity and emulsion stability are compared in between wheat flour and three composite flour having ratio of 25%, 50% and 75% of *Dioscorea bulbifera* flour with wheat flour. Functional properties of flours were shown in Table 1. LBD and PBD found lowest in wheat flour (0.38g/ml and 0.66g/ml) while highest in Dbf (0.51g/ml and 0.78g/ml) respectively. There was no significant difference in PBD between composite flours of (25%Dbf+75%Wf), (50%Dbf+50%Wf) and (75%Dbf+25%Wf). While LBD of (100% wf), (25% Dbf+75%wf), (50%Dbf+50%wf), (75%Dbf+25%wf) and (100% Dbf) were found to be 0.38, 0.44, 0.46, 0.49 and 0.51 respectively. (100%Wf) and (25%Dbf+75%Wf) received similar OAC value (0.92ml/g) at the same time (50%Dbf+50%Wf) and (75%Dbf+25%Wf) obtained related OAC value (1.84ml/g). Dbf had lowest EA value (42.10%) while (75%Dbf+25%Wf) obtained highest EA value (57.37%). There was no significant difference between EA value of (100%wf) and (50%Dbf+50Wf).

Proximate composition of Cookies

Incorporation of Dbf with wheat flour significantly increased the moisture content of composite flours. CO_3 (75%Dbf+25%wf) contained highest moisture content (18.95%) followed by 15.35% for (50%dbf+50%Wf), 11.21% for (25%Dbf+75% Wf) and 8.03% for (100%Wf). Ash content was gradually slightly enhanced with increase in percentage of Dbf in composite flour (CO_3, 3.51>CO_2, 3.45>CO_1, 3.36>CO_0, 3.24). Generally, cookies are poor sources of fiber but addition of dbf with wheat flour improve the fiber content of cookies. Fiber content also gradually increased with increase level of substitution of dbf to wheat flour (CO_3, 0.28>CO_2, 0.24>CO_1, 0.20>CO_0, 0.09). Highest amount of fat content found in wheat flour cookie which was gradually declined at 25%, 50% and 75% Dbf substituted cookies (CO_0, 24.37>CO_1, 22.97>CO_2, 21.90>CO_3, 19.40). This is may be due to Dbf is poor source of fat. Carbohydrate and protein content of cookies decreased gradually with increase level of dbf in cookies. Carbohydrate and

Table 1: Functional properties of flours.

Sample	LBD(g/ml)	PBD(g/ml)	OAC(ml/g)	WAC(ml/g)	ES(%)
1(100% Wf)	0.38±0.002^{a}	0.66±0.007^{a}	0.92±0.007^{ab}	1.42±0.07^{a}	54.01±0.6^{bc}
2(25%Dbf+75%Wf)	0.44±0.01^{b}	0.72±0.01^{bcd}	0.92±0.005^{ab}	1.80±0.09^{b}	56.01±0.76^{d}
3(50%Dbf+50%Wf)	0.46±0.01^{c}	0.71±0.004^{bcd}	1.84±0.004^{de}	2.46±0.05^{c}	53.72±0.84^{bc}
4(75%Dbf+25%Wf)	0.49±0.01^{de}	0.70±0.005^{bcd}	1.84±0.007^{de}	2.93±0.05^{d}	57.37±0.9^{e}
5(100% Dbf)	0.51±0.01^{de}	0.78±0.03^{e}	1.09±0.008^{c}	3.10±0.005^{e}	42.10±0.01^{a}

Means bearing same superscript within the same column are not significantly different (*P*>0.05). Wf: Wheat flour, Dbf:-*D. bulbifera* flour

Table 2: Proximate composition of Cookies.

Sample	Moisture(%)	Ash(%)	Fat(%)	Fiber(%)	Carbohydrate(%)	Protein(%)
CO_0	8.03±0.01^{a}	3.24±0.03^{a}	24.37±0.24^{d}	0.09±0.01^{a}	55.15±0.35^{d}	9.12±0.008^{d}
CO_1	11.21±0.007^{b}	3.36±0.02^{b}	22.97±0.007^{c}	0.20±0.008^{b}	54.32±0.01^{c}	7.94±0.02^{c}
CO_2	15.35±0.009^{c}	3.45±0.04^{c}	21.90±0.08^{b}	0.24±0.005^{c}	52.05±0.02^{b}	7.01±0.01^{b}
CO_3	18.95^{d}±0.009^{d}	3.51±0.06^{d}	19.40±0.22^{a}	0.28±0.008^{d}	51.08±0.02^{a}	6.78±0.14^{a}

Means bearing same superscript within the same column are not significantly different(P>0.05). CO_0= 100% Wheat flour, CO_1=25% *D. bulbifera* flour+75% wheat flour, CO_2=50% *D. bulbifera* flour+50% wheat flour, CO_3=75% *D. bulbifera* flour+25% wheat flour

Protein content were ranged between 51.08%-55.15% and 6.78%-9.12% respectively. Proximate composition of cookies presente in Table 2.

Proximate composition of Cake

Wheat flour cake contained lowest moisture, ash and fiber content than composite flour made cakes. Moisture content increased significantly with increased in level of Dbf in cake formulation (C_3, 30.37>C_2, 22.72>C_1, 16.71 >C_0, 10.40). Fiber content of cakes considerably improved with increased percentage of dbf in formulation (C_3, 0.32 >C_2, 0.31>C_1, 0.29>C_0, 0.11). Incorporation of dbf with wheat flour showed appreciable enhancement of ash in cakes (C_3, 3.2>C_2, 3.12>C_1, 3.06>C_0, 2.84). Accumulation of dbf to wheat flour leads to gradually degradation of carbohydrate content at 25%, 50% and 75% dbf substituted cakes (C_0, 58.62>C_1, 53.37 > C_2, 48.66>C_3, 42.84). Protein content in dbf substituted cakes gradually lower down with increase in ratio of dbf in formulation (C0, 8.84>C1, 8.01>C2, 7.05>C3, 5.86). Wheat flour cake contained significantly higher amount of fat than composite flour made cakes (C_0, 19.19>C_1, 18.56>C_2, 18.14>C_3, 17.41). Table 3 represents proximate composition of cake.

Sensory characteristics of cookies sample

Appearance of dbf substituted cookies were found to be superior to wheat flour cookies. 50% substituted cookies scored highest (8.40) for appearance followed by 75% substituted cookies (7.93), 25% substituted cookies (6.93) and wheat flour cookies (6.80). Taste of 25% substituted cookies was not found statistically different from wheat flour cookies at the same time 50% and 75% substituted cookies obtained statistically similar score for taste. Wheat flour cookies had lowest score (4.80) for texture. Incorporation of dbf in cookies formulation enhanced the texture of cookies. Flavour in wheat flour, 25% and 50% substituted cookies were not found significantly different but 50% substitution made highest flavored (8.33) cookies. 50% substituted cookies were found to be highest acceptable cookies in respect of appearance, taste, texture, and flavor. Scores

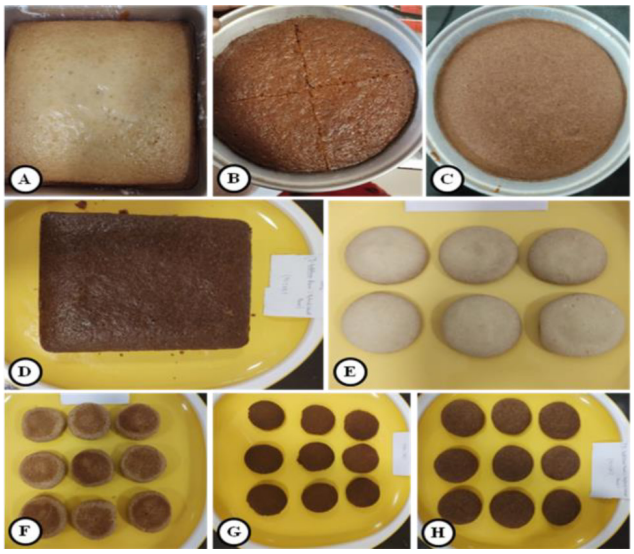

Figure 2: Images of prepared cookies and cake (A)100% wheat cake, (B)-25% dbf+75% wheat cake, (C) 50%dbf+50%wheat cake, (D)75% dbf+25% wheat cake, (E) 100% wheat cookies, (F) 25%dbf+75% wheat cookies, (G) 50% dbf+50% wheat cookies, (H) 75% dbf+25% wheat cookies.

Table 3: Proximate composition of cake.

Sample	Moisture	Ash	Fat	Fiber	Carbohydrate	Protein
C_0	10.40±0.01^a	2.84±0.11^a	19.19±0.36^d	0.11±0.005^a	58.62±0.41^d	8.84±0.09^d
C_1	16.71±0.02^b	3.06±0.10^{bcd}	18.56±0.26^c	0.29±0.01^b	53.37±0.58^c	8.01±0.26^c
C_2	22.72±0.009^c	3.12±0.10^{bcd}	18.14±0.14^b	0.31±0.007^c	48.66±1.68^b	7.05±0.02^b
C_3	30.37±0.01^d	3.2±0.11^{bcd}	17.41±0.17^a	0.32±0.008^d	42.84±0.10^a	5.86±0.05^a

Means bearing same superscript within the same column are not significantly different (P>0.05). C_0: -100% wheat flour, C_1=25% *D. bulbifera* flour+75% wheat flour, C_2=50%*D. bulbifera* flour+50% wheat flour, C_3=75% *D. bulbifera* flour+25% wheat flour

Table 4: Sensory characteristics of cookies.

Sample	Appearance	Taste	Texture	Flavour	Overall Acceptability
CO_0 (100%)	6.80±1.01^{ab}	5.66±1.29^{ab}	4.80±1.14^a	7.20±1.14^{abc}	6.11±0.58^a
CO_1(25Dbf:75Wf)	6.93±0.88^{ab}	6.66±1.63^{ab}	7.20±1.20^b	7.33±0.81^{abc}	7.03±0.61^b
CO_2(50Dbf:50Wf)	8.40±0.63^{cd}	8.33±0.81^{cd}	8.80±0.41^{cd}	8.33±0.61^{cd}	8.46±0.33^d
CO_3(75Dbf:25Wf)	7.93±0.59^{cd}	7.93±0.96^{cd}	8.13±0.51^{cd}	7.80±1.14^{abc}	7.95±0.47^c

Means bearing same superscript within the same column are not significantly different (P>0.05). Dbf: *D. bulbifera* tuber flour, Wf: Wheat flour

Table 5: Sensory characteristics of cake samples.

Sample	Appearance	Taste	Texture	Flavour	Overall Acceptability
C_0(100%Wf)	3.26±1.09^{a}	3.33±1.24^{a}	8.20±0.77^{cd}	2.33±1.23^{a}	4.28±0.59^{a}
C_1(25Dbf:75Wf)	7.20±0.77^{b}	7.66±0.72^{bcd}	6.53±0.83^{ab}	6.93±1.03^{bc}	7.08±0.45^{bc}
C_2(50Dbf:50Wf)	8.53±0.51^{cd}	8.33±0.81^{bcd}	7.46±1.12^{bc}	8.26±1.09^{cd}	8.15±0.48^{d}
C_3(75Dbf:25Wf)	8.06±0.96^{cd}	7.60±0.82^{bcd}	6.60±0.82^{bc}	7.80±1.14^{cd}	7.51±0.46^{bc}

Means bearing same superscript within the same column are not significantly different (P>0.05). Dbf:-*D. bulbifera* tuber flour, Wf: Wheat flour

of overall acceptability were found to be 8.46, 7.95, 7.03 and 6.11 for 50%, 75%, 25% dbf incorporated and wheat flour cookies respectively. Table 4 represents sensory characteristics of cookies.

Sensory characteristics of cake samples

Dbf substituted cakes scored significantly higher than 100% wheat flour cake in respect to appearance. C2 (50%Dbf: 50%Wf) and C3 (75%Dbf: 25%Wf) were not significantly different in case of appearance. Taste of cake notably increased due to incorporation of dbf in formulation. Wheat flour cake had lowest score (3.33) for taste while taste of 25%, 50% and 75% substituted cake were not statistically different. Incorporation of dbf in formulation resulted in decline of texture of cake. But flavor score of cookies greatly increased due to accumulation of dbf in formulation. 50% substituted cake found to have highest overall acceptability score (8.15) than 25%, 50% substituted cakes and wheat cake. Table 5 shows sensory characteristics of cake samples.

DISCUSSION

Functional property of wheat flour and composite flours

Bulk density of flour depends on moisture content and particle size of flour. BD refers to porosity of flour. Flour having high bulk density value may be used as thickeners in food product at the same time low density of flour is suitable for the making of nutrient rich weaning food.[16] Sanni *et al.*[17] reported higher value of LBD and PBD of wheat flour than present findings. Amandikwa *et al.*[7] reported lower value of LBD and PBD for dbf than present findings while Ojinnaka *et al.*[18] reported a range of 0.573-0.613g/cm^3 of bulk density for two cultivars of *Dioscorea bulbifera* flour. Sanni *et al.*[17] found OAC of wheat flour (0.96g/g) near to the present findings while Amandikwa *et al.*[7] found lower value of OAC (0.88ml/g) for wheat flour but Toan *et al.*[19] reported much higher value of OAC for wheat flour than present findings. Amandikwa *et al.* [7] reported higher value of WAC for dbf than present findings.

Proximate composition of cookies and cake

Moisture content

Moisture content of food products is a prime aspect in relation to storage potential of product. The lower the moisture content betters the shelf life of product.[20] Moisture content of wheat made cookies was found to be 8.03%. Previously Sanful and Essuman[9] reported lower value of moisture content that was 4.82% and 5.5% than present findings for wheat cookies and biscuit respectively. However, moisture content of composite flour made cookies and cakes ranged between 11.21-18.95% and 10.40-30.37% respectively which was higher than the previous findings.[9,4] This variation might have happened due to use of different making procedure. In this study moisture content gradually increases with increase in substitution of dbf to wheat flour in both cookies and cakes formulations. Enhancement of moisture content with increased level of dbf in wheat:dbf cookies, wheat:dbf bread and wheat:sweet potato cake respectively were also reported earlier.[10,7,21] In contrast Olatunde *et al.*[22] and Sanni *et al.*[17] reported degradation of moisture content with increased level of pigeon pea:sweet potato and sorrel seed protein isolate:yellow cassava flour substitution to wheat flour in cake and cookies formulations respectively. But Srivastava *et al.*[23] found no significant difference in moisture content in biscuits due to incorporation of sweat potato flour in treatment.

Ash content

Ash content represents mineral constituents of products after destruction of organic matter. Ash content of wheat cookies and cake was found to be 3.24% and 2.84% respectively. Ash content of Wheat-dbf cookies and cakes ranged between 3.36-3.51% and 3.06-3.2 respectively. Here ash content increased gradually with

increased level of dbf in formulation in both cookies and cake. This corroborate the earlier findings for wheat-dbf cookies and wheat-sorrel seed protein isolate-yellow cassava composite flour made cookies respectively.[10,17] Increase of ash content with increase percentage of sweet potato flour in cake formulation was also reported.[21,22] In contrast Oluwamukomi *et al.*[24] observed substitution of *Dioscorea bulbifera* flour and cassava flour to wheat flour decrease the ash content in cookies and biscuit respectively.

Fat content

Fat content of 100% wheat cookies and cake was found to be 24.37% and 19.19% respectively. Bansod *et al.*[10] reported lower value (19.98%) while Sanni *et al.*[17] found higher quantity (26.67%) of fat for wheat cookies in comparison of present findings. Incorporation of dbf at increase ratio in cookies and cake formulation caused the degradation of fat content gradually. In contrast Bansod *et al.*[10] reported increase of fat with increase proportion of dbf in formulation. Okorie and Onyeneke[21] also found enhancement of fat content with increase percentage of sweet potato flour in formulation of wheat-sweet potato cake. However, Oluwamukomi *et al.*[24] not found any significant difference of fat content in wheat-cassava flour composite biscuits. At the same time Olatunde *et al.*[22] found a significant difference in fat value of cakes made by wheat-pigeon pea-sweet potato composite flours.

Fiber content

Cookies and cake were found to attain very low amount of fiber content (0.09-0.32). Lowest amount of fiber was found in wheat cookies and cake. Increase level of dbf in formulation results the enhancement of fiber in both cookies and cake. Fiber content reported by Bansod *et al.*[10] support the present findings. Whereas, Sanful and Essuman[9] found no significant variation in fiber content in cookies due to the addition of Dbf in formulation. However Whole wheat cake had lowest fiber content while fiber content increase in composite flour made cakes with increase in level of pigeon pea and sweet potato in formulations.[22]

Carbohydrate content

Carbohydrate content of cookies and cakes was ranged between 51.08-55.15% and 42.84- 58.62% respectively. Increased proportion of Dbf in formulation resulted in a reduction of total carbohydrate both in cookies and cakes. This is in confirmity with the findings of Sanful and Essuman.[9] Sanni *et al.*[17] also found degradation of carbohydrate with increasing substitution of wheat flour with sorrel protein isolate and yellow cassava flour in cookies. Okorie and Onyeneke[21] also found same in case of wheat-sweet potato blend cakes. In contrast Olatunde *et al.*[22] found higher quantity of carbohydrate in cake made from composite flour containing wheat, pigeon pea and sweet potato than wheat made cake.

Protein content

Protein content of cookies and cakes ranged between 6.78-9.12% and 5.86-8.84% respectively. In earlier reported a ranged between 7.13%-9.15%, 8.02-9.29% and 7.74-9.51% of protein content for wheat-dbf flour made cookies and biscuit was reported respectively.[4,9,10] Here increases level of dbf in formulation caused degradation of protein content in both cookies and cakes. This was supported by Bansod *et al.*[10] and Okorie and Onyeneke[21] also found a decrease in protein content of the wheat: sweet potato composite flour made cakes as the level of potato flour substitution increased. Oluwamukomi *et al.*[24] also reported increase in the levels of cassava flours caused decrease in the protein content in biscuits from 13.04% to 8.4% in 100% wheat flour to 40% cassava flour substitution. However, Sanful and Essuman[9] found the enhancement of protein due to increase level of dbf in the baked cookies.

Sensory properties of products

Appearance

Acceptability of a product directly depends on its appearance. 50% substituted cookies and cake obtained highest score for appearance. Addition of dbf significantly increased the score of appearance of both cookies and cake. This finding corroborate to the previous report for wheat-dbf cookies and wheat-sweet potato cake.[10,21] In contrast, Sanful and Essuman[9] reported addition of dbf not significantly affect the product appearance. Nwosu and Justina[4] found highest score of appearance for wheat flour biscuit which was reduced due to addition of dbf in formulation. Etudaiye *et al.*[25] found reduction of colour when substitution level of cassava flour and sweet potato flour to wheat flour increases in biscuit and cake formulation respectively.

Taste

Increased percentage of dbf in product formulation significantly increased the taste of both cookies and cake. Wheat flour cookies and cake obtained lowest score while 50% substituted cookies and cake obtained highest score for taste by panelists. Bansod *et al.*[10] reported enhancement of taste due to incorporation

of increase level of dbf in cookies formulation. Sanful and Essuman[9] found statistically similar score of taste for wheat flour cookies, 50% and 80% dbf substituted cookies. Nwosu and Justina[4] reported highest score of taste for wheat flour cookies at the same time 10% and 20% dbf substituted cookies obtained closest score to the wheat flour cookies. However, Etudaiye *et al.*[25] found sweet potato and cassava flour substituted cake and biscuit had lower score of taste in comparison of wheat cake and biscuit respectively.

Texture

Dbf substitutions to wheat flour increased the cookies texture however decreased the cake texture. Bansod *et al.*[10] found enhancement of cookies texture at the same time Nwosu and Justina[4] reported degradation of cookies and biscuit texture due to incorporation of dbf in formulations respectively. However, Sanni *et al.*[17] found there was no significant difference in texture of wheat and wheat: sorrel seed protein isolate: yellow cassava flour made cookies. Srivastava *et al.*[23] found highest score of texture for 40% sweet potato flour substituted biscuit in comparison of 20%, 40%, 60%, 80%, 100% sweet potato substituted biscuits and 100% wheat biscuit.

Flavour

Flavour of cakes considerably increased due to incorporation of dbf in formulation. However, there was no significantly difference score of flavor found in wheat cookies, 50% and 75% substituted cookies by panelists. Bansod *et al.*[10] reported flavour of cookies gradually increased at level of 20%-60% substitution of wheat flour to aerial yam flour at the same time 80% substitution of aerial yam caused degradation of cookies flavor. Sanful and Essuman[9] found a ranged between 7.15-7.88 score of flavour for 50%-100% aerial yam flour substituted to wheat flour made cookies while at present study a ranged between 6.93-8.26 score of flavour for cookies and cake were recorded. Nwosu and Justina[4] reported increasing level of aerial yam substitution in biscuit preparation caused the degradation of flavour.

Overall acceptability

Over all acceptabilities of wheat made cookies and cakes were found to be lowest in comparison of wheat:dbf composite flours made cookies and cakes. Out of 25%, 50% and 75% of dbf substituted cookies and cakes, 50% substituted cookies and cakes obtained highest score for overall acceptability. Bansod *et al.*[10] reported 20%- 60% of substitution of aerial yam increase the acceptance of cookies in comparison to wheat flour cookies but 80% substitution decreased acceptance score. While Nwosu and Justina[4] found 10%-50% dbf substituted biscuits were acceptable but above 50% substitution was not suitable for biscuits making. Sanful and Essuman[9] reported wheat flour cookies mostly preferred by panelist and 50% substituted cookies was not significantly differing from wheat flour cookies in case of overall acceptability.

CONCLUSION

Result of the study revealed that replacement of wheat flour with dbf significantly affects the nutritional and sensory parameters of both cookies and cake. Moisture, ash and fiber content increase while fat, carbohydrate and protein content decrease with increased level of dbf substitution to wheat flour in formulation. Wheat cookies and cake obtained lowest score for all the sensory attributes in comparison of dbf substituted cookies and cakes. 50% replacement of wheat flour with dbf found to be most acceptable one in terms of appearance, taste, flavor and texture followed by 75% substitution. According to the result of present study Wheat-dbf composite flour can be used to make nutritious and appealing cookies and cake.

ACKNOWLEDGEMENT

Authors are thankful to OHEPEE, Govt. of Odisha under Centre of Excellence in Natural Products and Therapeutics, Sambalpur University through World Bank for Financial support. DST-FIST, Govt. of India for infrastructure support. Induar Sadhni acknowledges UGC, Govt. of India for RGNF Fellowship (201415-RGNF-2014-15-ST-ORI-70410).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

Dbf: *Dioscorea bulbifera* flour; **Wf:** Wheat flour; **AY:** Aerial yam; **CS:** Cassava flour; **BD:** Bulk density; **LBD:** Loose bulk density; **PBD:** Packed bulk density; **WAC:** Water absorption capacity; **OAC:** Oil absorption capacity; **EA:** Emulsion activity; **CO_3:** 75% *D. bulbifera* flour+25% wheat flour made cookies; **CO_2:** 50% *D. bulbifera* flour+50% wheat flour made cookies; **CO_1:** 25% *D. bulbifera* flour+75% wheat flour made cookies; **CO_0:** 100% Wheat flour made cookies; **C_3:** 75% *D. bulbifera* flour+25% wheat flour made cake; **C_2:** 50% *D. bulbifera*

flour+50% wheat flour made cake; **C_1:** 25% *D. bulbifera* flour+75% wheat flour made cake; **C_0:** 100% Wheat flour made cake.

SUMMARY

The current research paper deals with the proximate and sensory property analysis of a traditional wild tuber *Dioscorea bulbifera*.The cookies and cake made from the composite flour *D. bulbifera* and wheat is a good source of proteins, fibres, carbohydrates which may be use as a good source of food for the traditional people of that locality

REFERENCES

1. Polycarp D, Afoakwa EO, Budu AS, Otoo E. Characterization of chemical composition and anti-nutritional factors in seven species within the Ghanain yam germplasm. Int Food Res J. 2012;19:985-92.
2. Tindall HD. Vegetables in the tropics. 1st ed. London, Hampshire: Macmillan Education Ltd; 1983. p. 207-21.
3. Bhandari M. Nutritional evaluation of wild yam (Dioscorea SPP.) tubers of Nepal. Food Chem. 2003;82(4):619-23. doi: 10.1016/S0308-8146(03)00019-0.
4. Nwosu JN. Evaluation of the proximate and sensory properties of biscuits produced from aerial yam flour (*Dioscorea bulbifera*). Am J Res Communicat. 2014;2:119-26.
5. Seal T. Nutritional evaluation of some wild edible plants of Meghalaya state in India and their ethanobotanical importance. J Chem Pharm Res. 2015;7:2296-301.
6. Gurung GM. Chepang culture and economy: at cross road. In: Bhattarai TR, editor, Chepang resources and development 1995. p. 26-35.
7. Amandikwa C, Iwe MO, Uzomah A, Olawuni AI. Physico-chemical properties of wheat-yam flour composite bread. Niger Food J. 2015;33(1):12-7. doi: 10.1016/j.nifoj.2015.04.011.
8. Kayode RMO, Buhari OJ, Otutu LO, Ajibola TB, Oyeyinka SA, Opaleke DO, et al. Physicochemical properties of processed Aerial yam (*Dioscorea bulbifera*) and sensory properties of paste (Amla) prepared with cassava flour. J Agric Sci. 2017;12:84-94.
9. Sanful RE, Essuman EK. Effect of blanching on the proximate and sensory qualities of the Aerial yam composite cookies. Carib J Sci Tech. 2016;4:963-8.
10. Bansod PN, Ningot EP. P, Gawande S. Storage studies of aerial yam (*Dioscorea bulbifera* L.) flour cookies. J Pharmacol Phytochem. 2020;9:1428-33.
11. Okezie BO, Bello AB. Physicochemical and functional properties of winged bean flour and isolate compared with soy isolate. J Food Sci. 1988;53(2):450-4. doi: 10.1111/j.1365-2621.1988.tb07728.x.
12. Abbey BW, Ibeh GO. Functional properties of raw and heat processed cowpea flour. J Food Sci. 1988;53:1774-7.
13. Rangana S. Handbook of analysis and quality control for fruits and vegetable products. 2nd ed. New York: Tata Mc Graw-Hill publishing company Ltd; 2007.
14. Sadasivam S, Manickam A. Biochemical methods. 3rd ed New age international (p) Limited, publishers. New Delhi; 2008.
15. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. J Biol Chem. 1951;193(1):265-75. doi: 10.1016/S0021-9258(19)52451-6.
16. Adebowale AA, Adegoke MT, Sanni SA, Adegunwa MO, Fetuga GO. Functional Properties and Biscuit Making Potentials of Sorghum-wheat Flour Composite. Am J Food Technol. 2012;7(6):372-9. doi: 10.3923/ajft.2012.372.379.
17. Adesegun Sanni T. Quality assessment of cookies made from composite flour of wheat, sorrel seed protein isolate and yellow cassava flours. J Microbiol Biotechnol Food Sci. 2020;9(6):1073-9. doi: 10.15414/jmbfs.2020.9.6.1073-1079.
18. Ojinnaka MC, Odimegwu EN. Ilechukwu R. Funcational properties of flour and starch from two cultivars of aerial yam(*Dioscorea bulbifera*) in South East Nigeria. J Agric Vet Sci. 2016;1:22-5.
19. Toan NV, Anh NVQ. Preparation and improved quality production of flour and the made biscuits from purple sweet potato. J Food Nutr. 2018;4:1-4.
20. Sanni OL, Adebeowale AA, Filani TA, Oyewole OB, Westby A. Quality of ash and rotary dryer dried fufu flour. J Food Agric Environ. 2006;4:74-8.
21. Okorie SU, Onyeneke EN. Production and quality evaluation of baked cake from blend of sweet potatoes and wheat flour. 2012;2:171-7.
22. Olatunde SJ, Ajayi OM, Ogunlakin GO, Ajala AS. Nutritional and sensory properties of cake made from blends of pigeon pea, sweet potato and wheat flours. Food Res. 2019;3(5):456-62. doi: 10.26656/fr.2017.3(5).255.
23. Srivastava S. Preparation and Quality Evaluation of Flour and Biscuit from Sweet Potato. J Food Process Technol. 2012;03(12). doi: 10.4172/2157-7110.1000192.
24. Oluwamukomi MO, Oluwalana IB, Akinbowale OF. Physicochemical and sensory properties of sweet-cassava composite biscuit enriched with soy flour. Afric J Food Sci. 2011;5:50-6.
25. Etudaiye HA, Oti E, Aniedu C, Omodamiro MR. Utilization of sweet potato starches and flours as composite with wheat flours in the preparation of confectioneries. Afric J Biotechnol. 2014;14(1):17-22.

Cite this article: Induar S, Behera BC, Dubey D, Naik PK. Proximate and Sensory Properties of *Dioscorea Bulbifera* Composite Flour Made Cookies and Cake. Asian J Biol Life Sci. 2021;10(2):476-83.