International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(7): 971-976
www.biochemjournal.com
Received: 14-05-2024
Accepted: 24-06-2024

Nousheen Mohammad
Department of Food Science and Technology, Lovely Professional University, Punjab, India

Shivender Thakur
Department of Horticulture, Lovely Professional University, Punjab, India

Sunny Sharma
Department of Horticulture, Lovely Professional University, Punjab, India

Corresponding Author:
Nousheen Mohammad
Department of Food Science and Technology, Lovely Professional University, Punjab, India

Development and characterization of fortified biscuits incorporating pumpkin peel flour and water chestnut flour

Nousheen Mohammad, Shivender Thakur and Sunny Sharma

DOI: https://doi.org/10.33545/26174693.2024.v8.i7l.1640

Abstract
The present investigation "Development and chracterization of fortified biscuits incorporating pumpkin peel flour and water chestnut flour" was carried out in the Department of Food Science and Technology, Lovely Professional University, Phagwara, Punjab, India during 2023-2024. The experimental objectives were to assess physico-chemical characteristics of water chestnut flour and pumpkin peel flour and to develop biscuits with incorporating water chestnut flour (WCF) and pumpkin peel flour (PPF) as well as the physico-chemical and the sensory quality of the developed product. The experiment was laid out in a Completely Randomized Design (CRD) with four replications comprising of seven treatments *viz*., T_1: Wheat flour (control), T_2: [Pumpkin peel flour (10%) + Water Chestnut Four (10%)], T_3: [Pumpkin peel flour (20%) + water chestnut flour (0%)], T_4: [Pumpkin peel flour (0%) + Water chestnut flour (20%)], T_5: [Pumpkin peel flour (15%) + Water Chestnut Four (15%)], T_6: [Pumpkin peel flour (20%) + Water Chestnut Four (20%)] and T_7: [Pumpkin peel flour (0%) + Water chestnut flour (40%)]. Among different treatment combinations, significantly maximum acceptance during sensory analysis was recorded in T_2: [Pumpkin peel flour (10%) + Water Chestnut Four (10%)].

Keywords: Biscuits, fortification, pumpkin peel, water chestnut flour.

Introduction
Water chestnuts are native to several kinds of places, including islands in the Indian and Pacific oceans, Southeast Asia, Southern China, Taiwan, and Australia. They are used in a variety of Asian dishes, including chopsuey, curries, and salads, and they can occasionally be eaten raw or cooked (Rajput & Singh 2023) [36]. It is known that water chestnuts are packed with nutrients and are rich sources of fibre because they contain 12% of the recommended daily allowance for women and 8% for men in terms of fibre and have 75% of water (Vishwakarma *et al*., 2024) [23]. It is high in carbohydrates, low in calories, has very less amounts of lipid, small amounts of reducing sugar which is also mentioned in the study of Rajkumar & Rajithasri (2022) [15].

Eating foods high in fibre primarily aids in maintaining a healthy gut, lowering blood cholesterol levels, promoting regular bowel movements, and controlling blood sugar levels. One of the fruit's main benefits is that it helps to maintain blood pressure because it is a wonderful source of potassium. Those with high blood pressure who took more potassium saw their systolic and diastolic blood pressure drop by 3.49 mmHg and 1.96 mmHg, respectively. These individuals also had a lower risk of getting heart attacks. In the green and red kinds of water chestnuts, respectively, there were 0.275 mg and 0.251 mg (per 100 g) of water soluble protein. There was a large amount of starch in the red and green types of water chestnuts, 8.7 and 8.2 percent, respectively. Given their high air and water content and efficacy as a hunger suppressant, water chestnuts are regarded as large volume foods. It is also rich in phenolic compounds, vitamin C, minerals, iron, manganese, Sulphur, zinc, phosphorous and free amino acids and acts as an antioxidant (Kaur, 2022) [10].

Scientist's interest in pumpkin has grown as a result of its nutritional profile. It is a member of the *Cucurbita*ceae family and is a wholesome and affordable product. Due to its affordability and eco-friendliness, *Cucurbita pepo* L., *Cucurbita maxima* Duchesne, and *Cucurbita moschata* Duchesne are harvested all over the world. Because of its anti-inflammatory, antioxidant, antiviral, and antidiabetic characteristics, pumpkin is used as

medicine worldwide, but is especially popular in Austria, Hungary, Mexico, Slovenia, China, Spain, and other European, Asian, and African nations. Pumpkin is farmed for its peel, meat, and seeds all throughout the world. The majorities of the seed is big and contain a lot of poly- and monounsaturated fatty acids. Pumpkin seed oil contains significant amounts of the fatty acids linoleic acid, oleic acid, palmitic acid, tocopherols, ß-sitosterol, and delta-7-sterols. Pumpkin prevents CVD (cardiovascular diseases), acts as anticancer, anti-oxidative, anti-diabetic, anti- 7 inflammatory and is liver friendly. It has all the essential nutrients like carbohydrates, fibre, amino acids, tocopherol, delta-7-sterol and carotenoids in it. It has hypoglycemic properties, anticancerous, neuroprotective properties, anti-liver disease causing properties (Batool *et al*., 2022) [4].

The percentage of food lost after harvest is about 30%. A 25–30% loss is observed in roots, tubers, and oilseeds, compared to a 22% loss in fruits and vegetables. Fruit waste offers a chance to extract economically valuable substances like organic acids, proteins, essential oils, enzymes, bioactive compounds, aromatic substances, cellulose, pectin, and polysaccharides. These materials enhance the financial value that is obtained from fruit waste is said by Marsiglia-Fuentes *et al*., (2023) [12]. Pumpkin is a seasonal plant which have historically been fed to animals and used as food for humans. The fruit has a moderate amount of carbohydrates, vitamins, and minerals, along with a good amount of β-carotene (Nor, 2013) [14] classified the fractional composition of pumpkins as follows: 10-12% peel, 3-4% pulp, 79-82% flesh, and 4-6% seed. It was discovered that the fleshy portion of the pumpkin was the only part used in food processing, producing 18–21% of the waste produced by the pumpkin.

Materials

The water chestnut is an aquatic vegetable which were procured in the month of January from phagwara local market. Pumpkin seeds were procured from the local market where raw and ripe varieties were available in Phagwara, Punjab.

Methods

Laboratory methods and procedures used were adopted from (Tobaruela, *et al.*, 2018) [22] and A.O.A.C (1984) [1]. Total soluble solids, Moisture content, titrable acidity, pH, total phenolic content, carbohydrates, ash content, crude fat, tannins, flavonoid content, antioxidant activity were estimated in the flours and the biscuits.

Preparation of WCF and PPF

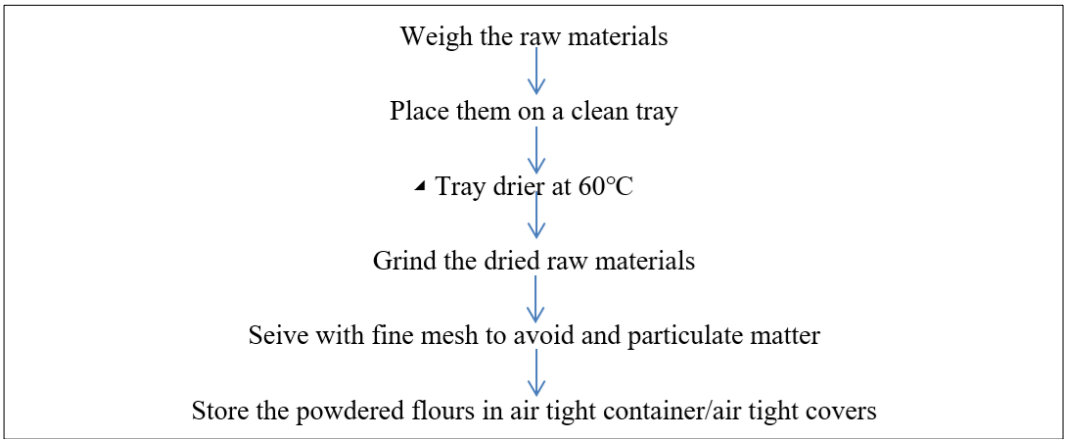

Fig 1: The procedure followed for flour preperation is a traditional method. The process followed for storage is given by George (2020) [7].

Treatment details

The biscuits were made by using creaming method following investigation. The treatment combinations following the fortification of water chestnut flour, Pumpkin peel flour and wheat flour are shown in table 1.

Table 1: Treatment details

Treatment	Wheat Flour (%)	Water chestnut Flour (%)	Pumpkin Peel Flour (%)
T_1	100	0	0
T_2	80	10	10
T_3	80	0	20
T_4	80	20	0
T_5	70	15	15
T_6	60	20	20
T_7	60	0	40

Sensory analysis

Sensory evaluation of samples of pumpkin peel flour and water chestnut flour fortified biscuits were carried out by a panel of 20 semi-trained judges. The panellist were given samples and asked to evaluate the samples for colour, texture, taste, aroma and overall acceptability by using 9-point hedonic scale (Annexure I) for each attribute in each product (Amerine *et al*., 1965) [3].

Results and discussion

Pumpkin peel flour is a nutrient-dense food with many health advantages. It is relatively low in water, with a moisture content of (6.89%), which aids in preservation. With a pH of about 4.30, the flour is slightly acidic. Its composition is primarily made up of carbohydrates (64.30%) and fat (20.05%), which adds to its energy content. Its 1.82% ash content further reflects its mineral content. Although it has a low protein content (0.9%), Tannins (21.09), fiber (11.28%) It is high in bioactive compounds (140 mg/100g of flavonoids and 190 mg/100g of total phenols). The antioxidant qualities of these phenolic and flavonoid compounds are well-known, and they have a number of health advantages.

Table 2: Chemical characteristics of Water chestnut flour and Pumpkin peel flour:

Parameters	Water chestnut flour (%)	Pumpkin peel flour (100 gm)
Moisture (%)	8.43±0.42	6.89±0.28
Ash (%)	2.02±0.12	1.82±0.03
TSS (˚B)	1.06±0.20	0.1±0.19
Titratable acidity	0.23±0.03	0.19±0.01
pH	6.36±0.01	4.30±0.01
Carbohydrate (%)	12.4±0.20	64.30±0.12
Protein (%)	4.19±0.25	0.90±0.15
Fat (%)	0.45±0.02	20.04±0.12
Crude fibre (%)	2.71±0.05	11.28±0.15
Total phenolic content (mg GAE/1000g)	4.17±0.01	19.00±0.08
Total flavonoid (mg QE /1000g)	1.98±0.04	14.00±0.04
Tannin (%)	0.14±0.01	21.09±1.91

Water chestnut flour is fiber rich and contributes to digestive and heart health. It has a pH of (6.36%). It has adequate amounts of water but the flour was dehydrated with the moisture content of 8.43. Ash and TSS with 2.02 and 1.06 respectively are present in the flour. Water chestnut flour is low in carbohydrates (12.4) and has high protein content of (4.16). Titrable acidity of water chestnut flour is 0.23 which is very low as it is not an acidic vegetable. WCF has very low fat content of (0.45%). It has high fiber content which is (2.71), Total phenolic content is (4.17 mg GAE/1000g) and Total flavonoid is (1.98 mg QE /1000g). The tannin content of WCF is (0.14%).

Table 3: Chemical characteristics of water chestnut and pumpkin peel fortified biscuits

Treatments (T)	TSS (˚B)	pH	Fiber content (mg/100g)	Flavonoid (mg QE /100g)	Total phenolic content (mg GAE/100g)	Antioxidant Activity (%)
T_1	0.20±0.00	6.98±0	2.16±0.00	52.75±1.02	69.22±0	9.87±0.00
T_2	0.10±0.00	7.23±0	4.09±0.03	123.00±1.47	219.24±0	13.27±0.00
T_3	0.11±0.00	7.02±0	5.03±0.01	127.54±0.86	240.43±0	17.59±0.51
T_4	0.21±0.00	7.07±0	3.21±0.00	92.133±0.64	259.77±0	15.56±4.50
T_5	0.21±0.00	7.02±0	4.09±0.03	121.65±0.40	252.57±0	17.38±0.00
T_6	0.11±0.00	7.09±0	4.21±0.00	122.20±0.89	252.54±0	17.10±0.00
T_7	0.20±0.00	7.06±0	5.028±0.01	130.33±0.43	248.06±0	16.62±0.00
C.D.	0.01	0.02	0.05	2.63	0.01	5.07
SE(M)	0.00	0.00	0.02	0.89	0.00	1.71

[T_1=control (100% WF), T_2= 80% wheat flour + 10% WCF+ 10% PPF, T_3=80% WF + 20% PPF, T_4= 80%WF + 20% WCF, T_5=70% WF + 15% WCF + 15% PPF, T_6=60% WF + 20% WCF + 20% PPF, T_7=60% WF +40% WCF]

From the Table 3 we can observe that T_4 displays the highest phenol content at 259.77 mg/100g, followed closely by T_6 with 252.66 mg/100g, indicating substantial concentrations of phenols in these samples. T_1 exhibits the lowest phenol content among the samples, measuring at 69.22 mg/100g, suggesting a comparatively lower concentration. Meanwhile, T_2, T_3, and T_5 fall within the mid-range, with phenol contents of 219.24, 240.43, and 252.54 respectively. Samples T_6 and T_4 exhibits more phenolic content since pumpkin peel flour has more phenolic content compared to water chestnut flour.

From Table 3 we can observe that sample T_4 and T_5 exhibits the highest TSS value at 0.21±0.00 in these samples. Following closely behind, T_1 and T_7 also shows a relatively similar TSS value of 0.20±0.00. Conversely, T_2 displays the lowest TSS value among the samples, measuring at 0.10±0.00. Meanwhile, T_3, T_6 fall within the mid-range, with TSS values of 0.11±0.00. The Total soluble solids doesn not vary that much but water chestnut tends to have slightly high as it has higher starch content. The values are higher than that of their study (Hussain, A, *et al*., 2022) [8-9] as there is fortification of water chestnut flour.

From the Table 3 we can observe that T_7 exhibits the highest flavonoid content at 130.33 mg/100g±0.43, indicating a significant presence of flavonoids in this sample. Following closely behind, T_3 also displays a notable flavonoid content of 127.54 mg/100g±0.86; T_1 shows the lowest flavonoid content among the samples, measuring at 52.75mg/100g±1.02, suggesting a comparatively lower concentration. Meanwhile, T_2, T_4, T_5 and T_6 fall within the mid-range, with flavonoid contents of 123.00±1.47 mg/100g, 92.13 mg/100g±0.64, 121.65 mg/100g±0.40 and 122.20 mg/100g±0.89, respectively. According to the findings of Shafi *et al*., 2017 [17] and Singh *et al*., (2011) [20] biscuits made with water chestnut flour have would have more flavonoid content which evidently seen in this experiment also were sample T_7 and T_3 exhibits more flavonoid content.

From Table 3 we can observe that sample T_2 exhibits the highest pH value at 7.23±0.01, indicating a relatively alkaline environment in this sample. Following closely behind, T_6 also shows a relatively high pH value of 7.09±0.00. Conversely, T_1 displays the lowest pH value among the samples, measuring at 6.98±0.00, suggesting a more acidic nature. Meanwhile, T_3, T_4, and T_5 fall within the mid-range, with pH values of 7.02±0.00, 7.07±0.00, and 7.02±0.00, respectively incudind T_7 with pH of 7.06±0.00 (Alam, H. M. *et al*., 2021) [2].

From the Table 3 we can observe that T_3 demonstrates the highest DPPH scavenging activity at 17.59%±0.51, indicating a significant ability to neutralize free radicals. Following closely behind, T_5 exhibits a notable scavenging activity of 17.38%±0.00, suggesting strong antioxidant properties. Conversely, T_1 shows the lowest scavenging activity among the samples, measuring at 9.87%±0.00, indicating a relatively weaker ability to scavenge free

radicals. Meanwhile, T_2, T_4, T_6 and T_7 fall within the mid-range, with scavenging activities of 13.27%±0.00, 15.56%±4.50, 17.10±0.00 and 16.62%±0.00, respectively. The results obtained were higher than the studies by shafi *et al*., (2016) [18] as there was fortification of pumpkin peel flour as in their Bemfeito *et al*., 2020 [5] studies.

From the Table 4 we can note that T_6 exhibits the highest protein content at 8.23%±0.04, indicating a substantial presence of protein in this sample. Following closely behind, T_2 and T_5 also shows a notable protein content of 8.10±0.04, 8.20%±0.03 respectively, suggesting a relatively high protein concentration. In contrast, T_1 display the lowest protein contents among the samples, measuring at 5.10%±0.03, indicating a comparatively lower protein composition. Meanwhile, T_3 and T_7 fall within the mid-range, with protein contents of 6.17%±0.02 and 6.25%±0.09, respectively. Results are similar to Din *et al*., 2024 [6].

From the Table 4 we can observe that the fat content in all the biscuits were almost similar as the amount of butter added for the preparation is in same amount which acts as an external source. The fat content in different formulations T_1, T_2, T_3, T_4, T_5, T_6, T_7 varies as 16.03±0.00, 16.10±0.00, 16.01±0.00, 16.18±0.00, 16.13±0.01, 16.11±0.00, 16.03±0.00 respectively. The average difference between all the formulations is 0.10%. The studies suggested that wheat flour has more fat content than the water chestnut flour as reported by Beigh, M. A. *et al*., (2020).

From the Table 4 we can observe that T_3 exhibits the highest carbohydrate content at 71.75%±0.01, indicating a substantial proportion of carbohydrates in this sample. Following closely behind, T_7 also shows a notable carbohydrate content of 71.44%±0.00, suggesting a relatively high concentration of carbohydrates. Conversely, T_1 displays the lowest carbohydrate content among the samples, measuring at 57.83%±0.17, indicating a comparatively lower carbohydrate composition. Meanwhile, T_2, T_4, T_5, T_6 fall within the mid-range, with carbohydrate contents of 70.67%±0.06, 71.18%±0.24, 70.45%±0.02, 70.22%±0.01 respectively. Similar results to Staichok *et al*., (2016) [21] and Khan *et al*., (2019) [11] were reported.

Fig 2: Biscuits with Different Varied Treatments

From the Table 4 we can observe the moisture content of biscuits across different treatments (T_1-T_{T7}) exhibits slight variations, ranging from 15.00% to 18.00%. T_3 has the lowest moisture content at 15.00%±0.31, while treatment T_7 has the highest at 18.00±0.37. Treatments T_1, T_2, T_4, T_5 and T_6 fall within intermediate moisture content levels showing subtle differences in moisture content. These variations may arise from differences in ingredients, baking processes, or environmental conditions during biscuits production (Singh *et al*., 2020, Nanyen *et al*., 2016) [19, 13]. Treatment T_1 has more moisture content than that of T_2, similarly in the case of treatment T_4 and T_5. In treatments were there is combination of flours that is T_3 and T_6 moisture content increases as the concentration of flour increases.

From the Table 4 we can note that T_1 exhibits the highest ash content at 1.88±0.02, indicating a substantial presence of ash in this control sample. Following closely behind, T_4 and T_7 also shows a notable ash content of 1.35±0.00, 1.26±0.00 respectively, suggesting a relatively high ash concentration compared to other samples. In contrast, T_2 and T_3 display S the lowest ash contents among the samples, measuring at 1.04±0.01, 1.04±0.00 respectively indicating a comparatively lower ash composition. Meanwhile, T_5 and T6 fall within the mid-range, with ash contents of 1.13±0.01, 1.13±0.01 respectively. Din *et al*., (2024) [6] reported that water chestnut flour has more ash content in it which is clearly notable from the above results.

From the Table 4 we can know that T_1, T_2, T_3. T6 have same titrable acidity which is 0.10±0.00. The other samples T_4, T_5, T_7 have titrable acidity of 0.18±0.00 the results are little lower than the study reported by Shafi *et al*., (2016) [18] and Din *et al*., (2024) [6].

From the Table 4 we can note that T_6 and T_4 exhibits the highest tannin content at 0.44%±0.00 and 0.42%±0.01 respectively indicating a substantial presence of tannin in this sample. Following closely behind, T_5 also shows a notable protein content of 0.39±0.04, 8, suggesting a relatively high tannin concentration. In contrast, T_1 display the lowest tannin contents among the samples, measuring at 0.12%±0.00, indicating a comparatively lower tannin composition. Meanwhile, T_2, T_3 and T_7 fall within the mid-range, with tannin contents of 0.34%±0.01, 0.33%±0.00 and 0.31±0.00, respectively.

Table 4: Physico Chemical characteristics of water chestnut and pumpkin peel fortified biscuits

Treatments (T)	Moisture Content (%)	Ash Content (%)	Titrable acidity (%)	Fat Content (%)	Protein Content (%)	Carbohydrates (%)	Tannins (%)
T_1	17.00	1.88±0.02	0.10±0.01	16.03±0	5.10±0.03	57.83±0.17	0.12±0.00
T_2	16.00	1.04±0.01	0.10±0.01	16.10±0	8.10±0.04	70.67±0.06	0.34±0.01
T_3	15.00	1.04±0.00	0.10±0.02	16.01±0	6.17±0.02	71.75±0.01	0.33±0.00
T_4	17.00	1.35±0.00	0.18±0.01	16.18±0	8.13±0.02	71.18±0.24	0.42±0.01
T_5	16.00	1.13±0.01	0.18±0.02	16.13±0	8.20±0.03	70.45±0.02	0.39±0.00
T_6	16.00	1.23±0.01	0.10±0.01	16.11±0	8.23±0.04	70.22±0.01	0.44±0.00
T_7	18.00	1.26±0.00	0.18±0.01	16.03±0	6.25±0.09	71.44±0.00	0.31±0.00
C.D.	2.54	0.04	0.03	0.02	0.14	0.34	0.02
SE(M)	0.84	0.01	0.15	0.01	0.04	0.11	0.01

Sensory evaluation

Data regarding the sensory evaluation of biscuits has been presented in the Table below, which showed the significant effect of different treatments on sensory attributes of biscuits of different concentration. The average overall acceptability (OAA) score for different biscuits ranged from 7.20-7.70 with maximum value for T_6 (7.70) and minimum for T_1 and T_5 (7.20).

The color rating ranges from 6.80 to 8.00. Treatment T_2 has the highest color rating, followed closely by T_3, T_4 and T_6. T_7 and T_1 had the lowest color rating. The texture ratings range from 7.00 to 8.20. Treatment T_5 has the lowest texture rating, while T_2 has the highest ratings. The taste ratings range from 7.00 to 7.80. T_5 has the lowest taste rating, while T_2 has the highest rating.

Aroma ratings range from 6.80 to 8.20. T_7 has the lowest aroma rating, while T_2 has the highest rating. The overall evaluation ratings range from 7.04 to 7.96. T_5 has the lowest overall rating, while T_2 has the highest rating. Comparing the average overall ratings, we can see that T_2 has the highest average rating of 7.96, followed by T_6 (7.46), T_3 (7.37), T_4 (7.26), T_7 (7.20), T_1 (7.08), T_5 (7.04).

Based on the given data, T_2 has the highest average overall rating (7.96) among the treatments, indicating that it received the highest combined score across all attributes including colour, texture, taste and aroma. T_2 with 10% supplementation of PPF and 10% of WCF was found to be the best treatment. T_2 had highest score in colour due to ppf was minimal and WCF imparrted good texture, taste and good aroma due to overall mixture. T_2 treatment having 10% of PPF and 10% of WCF has highest overall acceptability.

Table 5: Evaluation of fortified biscuits on the sensory characteristics / Sensory Evaluation-

Treatment	Colour	Texture	Taste	Aroma	Overall Acceptability
T1	6.80	7.20	7.20	7.00	7.20
T_2	8.00	8.20	7.80	8.20	7.60
T_3	7.20	7.80	7.40	7.00	7.40
T_4	7.20	7.20	7.40	7.40	7.10
T_5	7.00	7.00	7.00	7.00	7.20
T_6	7.20	7.40	7.40	7.60	7.70
T_7	6.80	7.40	7.40	6.80	7.60

Conclusion

Pumpkin peel is considered as a bio waste of pumpkin fruit which was processed into flour after performing various pre-treatments, this flour was added in various concentration to water chestnut flour to prepare biscuits that can be successfully utilized in its fresh and preserved form for the development of functional fortified cookie. These can be utilized as a better snack alternative, as it is rich in antioxidant activity and has good amounts of fiber and anti-oxidant activity. Sensory scores and chemical analysis of the cookie developed in the study revealed that the product had better taste, palatability and nutritive value. Pumpkin peel is rich in fiber and antioxidants, promoting digestive health and boosting immunity. Water chestnut flour adds vital minerals like potassium and magnesium, supporting heart health and bone strength. Together, they offer a nutritious, tasty snack that enhances overall well-being and meets diverse dietary needs. T_2: having Pumpkin peel flour (10%) & Water Chestnut Four (10%) is reccomended by our study as it is nutrient rich and has great sensory characterstics

References

1. AOAC. Association of Analytical Chemists. Standard Official Methods of Analysis of the Association of Analytical Chemists. 14th ed. Williams SW, editor. Washington, DC; c1984. p. 121.
2. Alam HM, Naeem R, Rubab G, Bilal H, Arooj H, Ashraf I, *et al*. Physicochemical properties of water chestnut. Pakistan Journal of Health Sciences; c2021. p. 08-13.
3. Amerine MA, Roessler EB, Ough CS. Acids and the acid taste. I. The effect of pH and titratable acidity. American Journal of Enology and Viticulture. 1965;16(1):29-37.
4. Batool M, Ranjha MMA, Roobab U, Manzoor MF, Farooq U, Rehan H. Nutritional value, phytochemical potential and therapeutic benefits of pumpkin (*Cucurbita* sp.). Plant. 2022;11(11):1394.
5. Benfeito S, Fernandes C, Vilar S, Remião F, Uriarte E, Borges F. Exploring the multi-target performance of mitochondriotropic antioxidants against the pivotal Alzheimer's disease pathophysiological hallmarks. Molecules. 2020;25(2):276.
6. Din GMU, Hussain A, Ashraf H, Kausar T, Fatima H, Akram S, Korma SA. Physicochemical, nutritional and organoleptic characteristics of biscuits based on water chestnut (*Trapa natans*) and wheat. Food Chemistry Advances. 2024;4:100691.
7. George SASSS. Preparation of pumpkin pulp and peel flour and study their impact in the biscuit industry. Journal of Biology, Agriculture and Healthcare. 2020;10(6):25-33.
8. Hussain A, Kausar T, Sehar S, Sarwar A, Ashraf AH, Jamil MA, Quddoos MY. Determination of total phenolics, flavonoids, carotenoids, β-carotene and DPPH free radical scavenging activity of biscuits developed with different replacement levels of pumpkin (*Cucurbita* maxima) peel, flesh and seeds powders.

Turkish Journal of Agriculture-Food Science and Technology. 2022;10(8):1506-1514.
9. Hussain Z, Iftikhar Y, Mubeen M, Saleem MZ, Naseer MU, Luqman M. Application of micronutrients enhances the quality of kinnow mandarin infected by citrus greening disease (Huanglongbing). Sarhad Journal of Agriculture. 2022;38:360-371.
10. Kaur G. Review based study on bioactive compounds and properties of water chestnut. The Pharma Innovation Journal. 2022;11(6):1843-1846.
11. Khan MA, Mahesh C, Vineeta P, Sharma GK, Semwal AD. Effect of pumpkin flour on the rheological characteristics of wheat flour and on biscuit quality. Journal of Food Processing and Technology. 2019;10(9):1-6.
12. Marsiglia-Fuentes R, Chiralt A, García-Zapateiro LA. Investigating the water relations in aqueous extract powders of mango (*Mangifera indica*) peel and seed waste for their use in food matrices as a value-added by-product. Foods. 2023;12(18):3497.
13. Nanyen D, Dooshima IB, Julius A, Benbella I. Nutritional composition, physical and sensory properties of biscuits from wheat, acha and mung bean composite flours. International Journal of Nutrition and Food Sciences. 2016;5(6):401-406.
14. Nor NM. Development of expanded snack foods containing pumpkin flour and corn grits using extrusion technology [Doctoral dissertation]; c2013.
15. Rajkumar P, Rajithasri M. Water chestnut: Growing conditions, nutritional and phytochemical composition, novel extraction methods and health properties. Pharma Innovation International Journal. 2022;11(7):599.
16. Rajput JD, Singh SP. Water chestnut (*Trapa natans* L.): Functional characteristics, nutritional properties and applications in food industry: A review; c2023.
17. Shafi M, Baba WN, Masoodi FA. Composite flour blends: Influence of particle size of water chestnut flour on nutraceutical potential and quality of Indian flat breads. Journal of Food Measurement and Characterization. 2017;11:1094-1105.
18. Shafi M, Baba WN, Masoodi FA, Bazaz R. Wheat-water chestnut flour blends: Effect of baking on antioxidant properties of biscuits. Journal of Food Science and Technology. 2016;53:4278-4288.
19. Singh A, Benjakul S, Huda N. Characteristics and nutritional value of biscuits fortified with debittered salmon (*Salmo salar*) frame hydrolysate. International Journal of Food Science and Technology. 2020;55(12):3553-3562.
20. Singh GD, Riar CS, Saini C, Bawa AS, Sogi DS, Saxena DC. Indian water chestnut flour-method optimization for preparation, its physicochemical, morphological, pasting properties and its potential in biscuits preparation. LWT-Food Science and Technology. 2011;44(3):665-672.
21. Staichok ACB, Mendonça KRB, dos Santos PGA, Garcia LGC, Damiani C. Pumpkin peel flour (*Cucurbita máxima* L.)-Characterization and technological applicability. Journal of Food and Nutrition Research. 2016;4(5):327-333.
22. Tobaruela EDC, Santos ADO, de Almeida-Muradian LB, Araujo EDS, Lajolo FM, Menezes EW. Application of dietary fiber method AOAC 2011.25 in fruit and comparison with AOAC 991.43 method. Food Chemistry. 2018;238:87-93.
23. Vishwakarma RK, Arora S, Bala M. Formulation and characterization of novel cereal gluten-free pasta from semi-popped makhana, water chestnut, and potato. Food and Bioprocess Technology; c2024. p. 1-16.