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Nutritional and sensory evaluation of baked wheat chips incorporated with lotus root (Nelumbo nucifera)

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Abstract

Snacks play a major parts of food consumption in children, adolescent and adult age group. Consumption of baked products is in increase over the years. Baking reduces the oil consumption and reduces the risk of disease due to the oil consumption. Addition of lotus root in appropriate portion can yield a healthy variation to baked chips. Lotus root contributes micronutrients such as iron and calcium. Whole wheat flour contributes fibre to the product. Thus the current study focused on the Nutritional and Sensory Evaluation of Baked Wheat chips incorporated with Lotus root (Nelumbo nucifera). Lotus root is mixed with wheat flour at different proportions such as 25% lotus root (V1) and 50% lotus root (V2). Baked chips with 100% Wheat flour was considered as Control sample(C). Proximate analysis showed that there is an increase in the nutritional values of the experimental samples compared to the control sample with the exception of the protein content and the replacement of wheat flour with the Lotus rhizome paste decreased the fat content and increased the Iron, calcium and fiber content in both VI and V2 samples of Lotus root blended wheat based baked chips. The results showed that 50% Lotus root could be included in a baked chips formulation for improving the nutritional value. A suvery was conduct through online questionnaire to understand the consumer perception about lotus root and baked chips. The result showed that most of the respondents were ready to accept baked lotus root chips for their health benefits, if it is commercialized.

Keywords: lotus root, baked wheat chips

Introduction

Lotus (Nelumbo nucifera Gaertn., family; Nymphaeaceae), a perennial aquatic crop, is one of two species of aquatic plant in the family Nelumbonaceae and widely cultivated throughout Orient. It is an important plant of economic value which produces roots that are very popular as a vegetable because of its crispness, attractive white color and abundant nutrients. They can be consumed either raw or cooked and are believed to be rich in health promoting compounds such as alkaloids, nuciferine and aporphine, lipids, phospholipids, flavonoids, carotenes, xanthophylls, and many minerals. Lotus rhizome, known as Lianngau or Ou in Chinese, is a staple food in many Asian countries, often used as ingredients in the preparation of important traditional food items, such as vegetable in soups, deep-fried, stir-fried, and braised dishes. (Li. S *et al*., 2017) [3].

The influence of wheat flour on baked-product character is more commonly expressed on the basis of its composition, protein, starch, fibre content and other important physicochemical properties, such as particle size and protein quality. It is therefore possible to consider the influence of flour on structure formation using such properties. The key role of wheat-flour protein in the formation of the gluten structure is essential. In general, an increase in the protein content leads to an increase in the gas retention properties of the dough and therefore an increase in volume. The extent to which the product volume will increase depends on a number of recipe and process factors. It also depends on the ability of the wheat proteins to form a gluten network with the appropriate rheological properties. Such properties are strongly influenced by protein-quality attributes, which are notoriously difficult to define, measure and, to some extent, standardise. (Cauvain, S.P. and Young, L.S,2006) [2].

Consumption of baked products is in increase over the years. By witnessing the trends, chips have become one of the prominent food industry investments. Consumers are constantly looking for newer, low fat- healthier snack foods to satisfy their taste buds. Snacks plays a major parts of food consumption in children, adolescent and also in adult age group. Increased fat consumption has shown negative health effects. Baking reduces the oil consumption and reduces the risk of disease due to the oil consumption. Addition of lotus root in appropriate portion can yield a healthy variation of baked chips. Lotus root contributes micronutrients such as iron and calcium. Whole wheat flour contributes fibre to the product. Thus the current study focused on the Nutritional and Sensory Evaluation of Baked Wheat chips incorporated with Lotus root (Nelumbo nucifera).

General objectives

To develop a Ready-to-eat baked wheat chips incorporated with lotus root.

Specific objectives

To develop a Ready-To- Eat (RTE) baked wheat chips incorporated with lotus root.

To evaluate the organoleptic characteristics of baked wheat-lotus root chips.

To increase the nutritional value of wheat chips by incorporating it with lotus root.

To reduce the oil consumption in snack by baking process.

Materials and Methods

Raw Materials Procurement

The Fresh lotus roots (rhizome) and whole wheat flour was procured from local market, Chennai. Oven toaster griller (OTG) Wonderchef brand (28L) was used for baking chips.

Preparation

Lotus root (100g) is washed, peeled, cut into small pieces and grinded in a mixer. The grinded paste is boiled in hot water (20 ml). The gelatinized lotus root paste is mixed with wheat flour at different proportion. Then the dough is spread into thin sheets and cut into round chips shape and baked at 180^0C for 15mins.

Table 1: Formulation of Baked wheat chips incorporated with different concentration of Lotus root

Sample	Wheat flour (g)	Lotus root (g)
Control	100g	-
V1	75g	25g
V2	50g	50g

Nutritional Analysis

Estimation of Moisture and Ash

Estimation of moisture and ash was done using AOAC 2000 method.

Extimation of Carbohydrates

% Carbohydrate= 100- (protein + fat + moisture + fibre + ash)

Estimation of Protein by Kjeldhal Method

Total protein = % Nitrogen*6.25

Nitrogen percentage was found by Digestion, neutralization, distillation, titration was done using Pelican (brand) Nitrogen Kjeldhal Distillation System.

Estimation of Fat by Soxhlet Method

Weigh the empty thimble (W1g) and transfer 8 -10 grams of sample into the thimble (W2). Fix the Soxhlet extractor and place a weighed flask (W3). Place the sample in extractor and add petroleum ether in excess. Fix the water condenser over the extractor, run the extraction set for 14- 16 hours. Disconnect the flask, evaporate the solvent. Remove the final traces of the solvent by heating in the oven at 60- 700 ° C for 30 minutes. Cool and note down the weight of the flask (W4). Conduct the experiment in duplicate.

Calculation

% of fat = (Weight of fat x 100) / weight of the sample (Were weight of fat is W4 – W3 and weight of sample is W2-W1)

Estimation of Crude fibre

Weigh 5g of the sample into a 500ml beaker and add 200ml of boiling 0.255N Sulphuric acid. Boil the mixture for 30 minutes; keeping the volume constant by adding water at frequent intervals (a glass rod inserted in the beaker helps smooth stirring and boiling). At the end of the period, filter the mixture through a muslin cloth and wash the residue with hot water till free from acid. Transfer the mixture to a beaker containing 200ml of boiling 0.313N sodium hydroxide. After boiling for 30 minutes (keeping the volume constant as before) filter the mixture through a muslin cloth. Wash the residue with hot water till free from alkali followed by washing with some alcohol and ether. Transfer it into a crucible, dry overnight at 80-100°c and weigh. Heat the crucible in a muffle furnace at 600°c for 2-3 hours. Cool and weigh again. The loss in the weight represents the weight of the fibre.

Calculation

Weight of the crucible =

Weight of crucible with fibre content = (after heating in tray drier)

Weight of crucible with fibre content = (after heating in muffle furnace)

Crude fibre (g/100g) = Loss in weight noted x 100/Wt of the sample taken

Estimation of Iron

Ash solution of the sample prepared by dry ashing for iron content estimation. Pipette 0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 of standard solution to test tubes and 0.5 and 1 ml sample solution in unknown test tube. Add 0.5 ml of concentrated H2SO4. 1ml of Saturated potassium per sulphate, 2 ml of 3N potassium thiocyanate and make up the volume to 15 ml. Measure the colour at 480A as early as possible. Plot the absorbance against concentration. The concentration of iron in the aliquot of the sample can then be read directly from the calibration curve. Standard Iron Solution is used as standard.

Estimation of Calcium

Pipette an aliquot (20 to 100ml) of the ash solution obtained by dry ashing to a 250 ml beaker. Add 25 to 50 ml of water if necessary. Add 10 ml of saturated ammonium oxalate solution and 2 drops of methyl red indicator. Make the solution slightly alkaline by the addition of dilute ammonia and then slightly acid with a few drops of acetic acid until the colour is faint pink (pH 5). Heat the solution to boiling point. Allow to stand at room temperature for at least 4 hour or preferably overnight. Filter through the Whatman No.42 paper and wash with water, till the filtrate is oxalate free. Break the point of filter paper with a glass rod. Wash the precipitate first using hot dilute H2SO4 1+4 from wash bottle in to the beaker in which the calcium was precipitated. Then wash with hot water and titre while still hot (temperature 70 to 80*C) with 0.01 N KMnO4 to the first permanent pink colour. Finally add filter paper to solution and complete the titration.

Calculation

Calcium mg/100g = Titre x 0.2x total volume of ash solution x 100/ Volume of ash solution taken for estimation x Wt of the sample taken for ashing

Sensory Analysis

The samples was evaluated for sensory attributes (appearance, colour, aroma, taste, texture (crispness), after taste and overall acceptability) using 9- Point Hedonic Scale. This was done by 30 semi-trained panelists who represent the common consumer.

Survey
A survey was conducted to understand the perception about lotus root and baked wheat chips among the consumer who aged between 20 to 23. A pre structured questionnaire was formulated to the respondents using Google form.

Results and Discussion

Table 2: Nutritional analysis value

Sample	Moisture (%/100g)	Ash (%/100g)	Carbohydrate (%/100g)	Protein (%/100g)	Fat (%/100g)
Control	14.07±0.23	0.78±0.02	88.73±0.45	9.51±0.24	0.51±0.13
V1	15.02±0.56	0.83±0.02	87.65±1.52	9.15±0.6	0.53±0.11
V2	16.19±0.60	0.96±0.07	86.89±0.35	8.31±0.11	0.36±0.14

Table 3

Sample	Crude Fibre (g/100g)	Iron(mg/100g)	Calcium(mg/100g)
Control	0.46±0.09	17.38±2.66	15.15±0.73
V1	1.82±1.19	31.99±5.64	16.06±0.94
V2	3.46±0.42	43.99±1.74	18.12±0.35

The moisture content of the sample ranged from 14.07% – 16.19%. Control is significantly ($p<0.05$) different from V1 and V2. There is no significant difference ($p>0.05$) between control and V2. The moisture content increases with increase in concentration of lotus root. (Talukder S *et al.*, 2014) [5] reported increase in moisture values with increase in chicken meat ball incorporated with lotus root powder. The ash content indicates s a rough estimation of the mineral content of the product. The ash content of the sample increases with increase in concentration of lotus root. Mean of Control and V1 is almost same. V1 is significantly different ($p<0.05$) from V2. Control is significantly different ($p<0.05$) from V2. (Thanushree M. P *et al.*, 2017) [7] reported that there is a increase in ash content in baked wheat bread sticks when lotus root powder is incorporated to improve its nutrient value. This indicates the mineral content of lotus root is higher than wheat flour. The carbohydrate value ranged from 86.89%- 88.73%. There is no significant difference ($p>0.05$) between control, V1 and V2. This shows that the carbohydrate value were nearly same in wheat flour and lotus root. There is no significant difference ($p>0.05$) between Control and V1. V2 is significantly different ($p<0.05$) from Control and V1.The protein value ranged from 8.31- 9.51%. The protein value decreased with increase in lotus root concentration. The fat content decreased with increase in lotus root concentration this is due to the low content of fat in the lotus root than wheat flour. There is no significant difference ($p>0.05$) between control, V1 and V2. The crude fibre content increased with increase in lotus root concentration. There is no significant difference ($p>0.05$) from Control and V1. V2 significantly differ ($p<0.05$) from Control and V1. The iron content increased with increased in lotus root concentration. Control, V1 and V2 significantly differ ($p<0.05$) from each other. V2 had the highest concentration of iron. The calcium content of the samples increased with increase in lotus root concentration. The calcium value ranged from 15.15- 18.12 There is no significant difference between control and V1. V2 is significantly different from control and V1. (Sruthi A *et al.*, 2019) [4] reported that lotus root contains 40mg of calcium per 100g which is more than calcium content present in wheat flour. Thus there is an increase in calcium content with increase in lotus root concentration.

Sensory

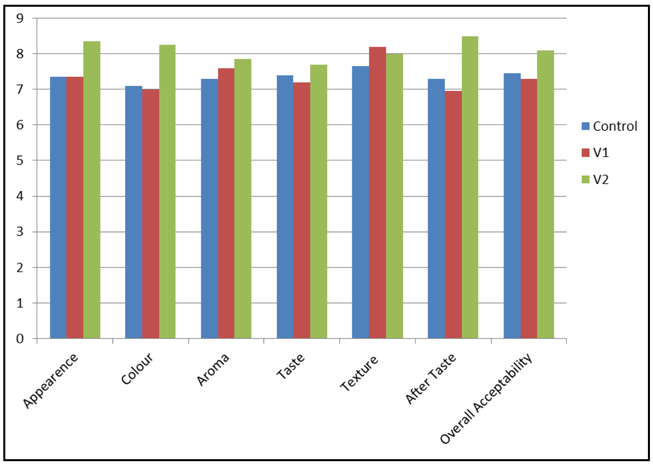

Fig 1: Sensory analysis

Survey
A survey was conducted to understand the consumer perception on consuming lotus root and baked wheat chips. The survey was filled by 50 respondents. According to the result obtained:

34% of respondents are not aware that lotus root is edible and 66% of respondents are aware that lotus root is edible. 28% of respondents know how to cook lotus root and 72% of the respondents are dont know how to cook lots root. Among those 28% respondents 10.7% prefer baking, 25% prefer steaming, 28.6% prefer baking and 35.7% prefer frying the lotus root. 36% of respondents have eaten lotus root and 64% of respondents have never eaten lotus root. 24% respondents consume chips daily, 34% respondents consume chips monthly once, 26% respondents consume weekly once and 16% respondents never consume chips. 44% of respondents have eaten wheat chips and 56% of respondents have never eaten wheat chips. 62% respondents think that consuming lotus root is healthy and 38% of respondents think consuming lotus root is not healthy. 76% of the respondents think that consuming lotus root does not cause any health effect on human body and 24% respondents think that consuming lotus root cause health effect. 46% of respondents consider eating lotus root chips if it commercialized, 46% respondents answered “May be consider” to eat lotus root if commercialized and 8% of respondents are not ready to eat lotus root if it is commercialized. 74% of respondents prefer eating baked chips while other 26% of respondents does not prefer baked chips. 62% of respondents were aware about baked chips available in the market and 38% of respondents are not. “Too yumm” and “Pringles” were the two baked chips brand that was known by 62% of respondents who are aware about baked chips. The result shows that most of the respondents will accept baked lotus root chips if it is commercialized. People will accept this kind of product for their health benefits.

Conclusion
In this study, Lotus root blended wheat based baked chips was developed and analysed for different physical characteristics and sensory properties. Lotus root in Wheat flour based products like wheat chips can improve the health of consumers. The results showed that 50% Lotus root could be included in a baked chips formulation for improving the

nutritional value. We may conclude that since lotus rhizome is a good source of mineral, calcium, iron with high fibre, substitution of Wheat flour with Lotus root in Wheat flour based products like baked chips can improve the health of consumers. Further, this formulation can be considered to widen the use of rhizomes in bakery industry.

Limitations

Availability of Lotus root is minimum in the market.
Cost of the Lotus root varies in different season

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