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Nutritional Evaluation and Analysis of Water Chestnut Chips

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Abstract—*Water chestnut flour (WCNF) is an excellent source of energy due to its high starch content. It can be eaten raw, boiled and roasted and used as food. Water chestnut contains higher amount starch, protein, saccharide, essential amino acids and some microelement (potassium, calcium, magnesium, zinc etc.) Chestnut is rich source of starch (50-60% of dry matter, d.m.), protein (4-7%, d.m.), fat (2-4% d.m.), dietary fiber (4-10%, d.m.). It also contain free sugars including sucrose, glucose, fructose and maltose), vitamin including C, E and B groups. Chestnut is spoiled due to its high water contain. Chestnut is sweet in taste and highly nutritional fruit. In India, chestnuts are used during fasting days, used as dried and the flour form. Due to low fat content chestnut are helpful for dieting. Chips were analysed for their proximate composition i.e. moisture, ash, fat, crude fibre, protein, carbohydrate, etc. The moisture content of olive oil fried chips was higher than soybean oil and mustard oil fried chips. It has also been analysed that ash content of mustard oil fried chips was higher than soybean oil and olive oil fried chips. Fat content of soybean oil fried chips was higher than mustard oil fried chips. Color and texture of olive oil fried chips appeared to be better than mustard oil and soybean oil fried chips.Water chestnut beneficial for people suffering from jaundince. Water chestnuts have anti-bacterial, antiviral, anticancer and antioxidant properties. Water chestnut decreases the risk of cardiovascular, diabetes and obesity and also to control the level of blood glucose.*

1. INTRODUCTION

Water chestnuts commonly known as Singhara (Trapa bispinosa Roxb.) in Indian. It is an edible aquatic angiospermic plant found commonly on the water surfaces of lakes and ponds. Water chestnut flour (WCNF) is an excellent source of energy due to its high starch content (De Vasconcelos, Bennet, Rosa, & Ferreira-Cardoso, 2010). It can be eaten raw, boiled and roasted and used as food. Water chestnut contains higher amount starch, protein, saccharide, essential amino acids and some microelement (potassium, calcium, magnesium, zinc etc.) (Ribeiroa et al., 2013; Montana Migueleza et al., 2004; Olga et al., 2008; Yu et al., 2011). Liang et al., (2013) reported that the fat contain in chestnut about 1-5%. Four major species of chestnut in the world are Castanea crenata in Japan, C. sativa in Europe and South America, C. dentate in North America, and C. mollissima in China. Water chestnuts have incredible nutritional value and making them an excellent food source. It acts as an excellent coolant for the body (Rani et al., 2016). They are high in nutrients and low in calories and almost fatless. Chestnut is rich source of starch (50-60% of dry matter, d.m.), protein (4-7%, d.m.), fat (2-4% d.m.), dietary fiber (4-10%, d.m.). It also contain free sugars including sucrose, glucose, fructose and maltose), vitamin including C, E and B groups (De Vasconcelos et al., 2010). Chestnut is spoiled due to its high water contain. Chestnut is sweet in taste and highly nutritional fruit (Zhu, F., 2016).In India, chestnuts are used during fasting days, used as dried and the flour form. Due to low fat content chestnut are helpful for dieting (Puste,2004).

In India, Chestnuts are available in Punjab, Bihar, Uttar Pradesh, Madhya Pradesh, Tamilnadu, Maharashtra and in some parts of Uttrakhand (Singh et al, 2010).Water chestnut beneficial for people suffering from jaundince. Water chestnuts have anti-bacterial, antiviral, anticancer and antioxidant properties reported by Rani et al., 2016.

Water chestnut decrease the risk of cardiovascular, diabetes and obesity and also to control the level of blood glucose (Mariscal-Moreno et al., 2017).

2. MATERIAL AND METHODS

Raw Material

Water chestnut, sendha salt and ghee are purchased from local market of Sirsa. Distilled water was taken for preparation of chips. High density polythene bags were used for the packaging of chips and the chips were stored at cool and dark place.

Preparation of water chestnut flour

Various pre-treatments were given to water chestnut slices before drying in the process of optimizing method of flour preparation. Water chestnut flour is prepared by the process:

Water chestnut

↓
Grinding
↓
Sieving (177 µm)
↓
Water chestnut flour
↓
Packaging
(Double polythene and storage at room temperature)

Chips Preparation:

All the ingredient were weighed including water chestnut flour(200g), salt(2g), red chili powder(1g), cumin powder(2.5g), mix spices(1.5g), black pepper powder(1.5g). After weighing, the entire dry ingredients were mixed. After this, water was added and mixing by spoon, till a thin and uniform paste was ready. This paste was heated at the flame for two to five minutes. Further, paste is spreaded in chip like structure on cookie sheet on which ghee (4-5g) is spreaded. Chips were dried (sun drying). Dried chips were then pan fried in refined oil for 25-30sec at 140°C.

2.3 Proximate Analysis

The fried and baked chips were tested for moisture, ash, fat, fiber and protein contents by employing the standards methods of analysis (AOAC, 2005). The carbohydrate content was calculated by difference. All the results were recorded on a dry weight basis.

2.4 Determination of Salt Analysis:

The addition of standard silver nitrate to sample solution using potassium chromate as the visual indicator, yields an insoluble precipitate which is proportional to the amount of total chlorides in the solution. The red colored silver chromate complex, formed by the combination of $AgNO_3$ and K_2CrO_4 is soluble in acid and loses its color. The salt contents of the sample may be calculated from the volume of standard $AgNO_3$ used to reach the end point (Mohr method, 1991).

Calculations:

$$\text{Salt \%} = \frac{\text{(sample titer – blank titer) (N of silver nitrate) (5.84)}}{\text{Weight of sample taken}}$$

2.5 Determination of Acidity Analysis:

Food acidity is the important parameter in foods besides affecting flavor. Food acidity affects the ability of microorganisms to grow in the food. Microorganisms prefer minimal acidity and are prevented from growing when acid level gets high enough. Titrable acidity of a solution is an approximate of solutions total acidity. The titrable acidity of a solution is measured by reacting acid present with the base such as a sodium hydroxide to a chosen end point; lose to neutrality as indicated by an acid sensitive colour.

About 5g of crushed rice chips sample into a beaker and add 100ml of distilled water to it. Put few drops of 1%phenolphthalein to it as indicator. Then titrate the solution with 0.05N NaOH, Change in color (pink color) indicates at the end point. Note the titrated value and Cary out a blank determination using water only (AOAC, 2000).

Calculations:

$$\text{Acidity \%} = \frac{\text{(titer value) (normality of NaOH) (factor)}}{\text{Weight of the sample taken}}$$

2.6 Sensory Evaluation of Chips:

Chips prepared from different samples were subjected to sensory evaluation by panel of eight people. Samples were fried and baked, and then evaluated for colour, texture, odour, flavor, and taste. Between tasting different samples, members rinsed their mouth with water. Participant did not receive any information about nature, contents and nutritive value of chips.

2.7 Statistical analysis

The data shown in all the tables are an average of triplicate observations and were subjected to one way analysis of variance (ANOVA) using Minitab statistical software version 14 (Minitab Inc, USA).

Result

Chemical composition of rice chips were presented in Table 1. It was obvious that the fried chip has higher fat content in Soybean oil than the Mustard oil and Olive oil.

Table 1: Proximate composition of water chestnut chips in different oil:

Parameter	Mustard oil fried chips	Soybean oil fried chips	Olive oil fried chips
Moisture (%)	2.08 ± 0.31	4.00 ± 0.34	4.21 ± 0.31
Ash (%)	3.81 ± 0.03	2.62 ± 0.12	2.02 ± 0.03
Fat (%)	34.01 ± 0.01	36.23 ± 0.04	33.01 ± 0.01
Crude Fibre (%)	0.20 ± 0.05	0.20 ± 0.05	0.24 ± 0.05
Protein (%)	9.50 ± 0.87	9.48 ± 0.86	8.50 ± 0.87
Carbohydrate (%)	50.50 ± 0.37	48.0 ± 0.41	53.45 ± 0.27
Salt analysis (%)	2.07 ± 0.05	2.27 ± 0.02	2.07 ± 0.05
Acidity analysis (%)	0.20 ± 0.56	0.82 ± 0.52	0.57 ± 0.56

The moisture content of fried chips for Mustard oil, Soybean oil and Olive oil varied from 2.08 ± 0.31 % to4.21 ± 0.31%. The protein, fiber and fat content of fried chips for Mustard oil, Soybean oil and Olive oil ranged between8.50 ± 0.87% to9.50 ± 0.87%, 0.20 ± 0.05% to 0.24 ± 0.05% and 33.01 ± 0.01% to 36.23 ± 0.04% respectively. Fried chips for Mustard

oil, Soybean oil and Olive oil exhibited ash and total carbohydrates content in the range of 2.02 ± 0.03% to 3.81 ± 0.03% and48.0 ± 0.41% to 53.45 ± 0.27% respectively. In addition, salt and acidity of fried chips for Mustard oil, Soybean oil and Olive oilranged between 2.07± 0.05% to2.27 ± 0.02% and 0.20 ± 0.56% to 0.82 ± 0.52% respectively.

Mustard oil fried chips

Soyabean fried chips

Olive oil fried chips

Sensory Evaluation of Chips:

Chips made from water chestnut flour and commercial chips were evaluated for texture, flavor, color, firmness and overall acceptability by sensory evaluation.

The texture values reported as breaking force can reflect the crispness of the chips which is the most important textural attributes of crisps and chips that denotes freshness and high quality. Textural quality of chips was measured in terms of their crispness and crunchiness.

Some foods exhibit a tendency to adhere to a contact surface, which is generally known as stickiness. This stickiness can be perceived in the palate, teeth, and tongue when the food is being masticated. The term flavor is intended to encompass both taste and smell properties of food. All sensory values for different types of chips are given in the table:

Sample	Color	Stickiness	Texture	Flavor	Overall Acceptability
Mustard oil	7.12±0.67	5.80±0.66	8.34±0.23	9.45±1.20	7.32±0.78
Soybean oil	7.13±0.69	5.82±0.67	8.31±0.23	9.47±1.22	7.30±0.80
Olive oil	7.15±0.65	5.81±0.69	8.35±0.25	9.48±1.18	7.36±0.78

Frying Time and Temperature:

Sample	Frying Temperature ($^{\circ}$C)	Frying Time (sec)
Mustard oil	130-140^{0}C	30-40sec
Soybean oil	130-140^{0}C	30-40sec
Soybean oil	130-140^{0}C	30-40sec

Result of the sensory profile for color, taste, mouth feel and general acceptability are shown in Table 3 that the colour of Olive oil chips was higher than the Mustard oil and soybean oil chips. The colour of chips was higher in compare to all other chips which was due to slight millard browing of aldehydic groups and amines. The texture of Olive oil chips was higher than the Mustard oil and soybean oil chips.

The overall acceptability of Olive oil chips was higher than the other.

Conclusions

Chips were analysed for their proximate composition i.e. moisture, ash, fat, crude fibre, protein, carbohydrate, etc. It was observed that moisture content of olive oil fried chips was higher than soybean oil and mustard oil fried chips. It has also been analysed that ash content of mustard oil fried chips was higher than soybean oil and olive oil fried chips. Fat content of soybean oil fried chips was higher than mustard oil fried chips. Color and texture of olive oil fried chips appeared to be better than mustard oil and soybean oil fried chips.

Thus, it is recommended that the consumption of chips from olive oil fried is much more acceptable in every respect (easily digestible, rich in fibers, much more like by people as well as children and with incorporation of more ingredients it could be much tastier in nature.

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