Tropical Agricultural Research Vol. 27 (4): 420 – 426 (2016)
Short Communication

Development of O*lu* (*Nymphaea pubescens Willd)* Seed Flour Incorporated Cookies and Determination of Organoleptic Properties

N. Nizam and P.C. Arampath[1*]

Postgraduate Institute of Agriculture
University of Peradeniya
Sri Lanka

ABSTRACT: *The research was conducted to investigate the potential of incorporation of Olu (white water lily or hairy water lily), Nymphaea pubescens Willd seeds flour with wheat flour in cookies and evaluation of their organoleptic properties. The proximate composition of Olu seed samples was determined. The control (wheat flour) and six cookie formulations replacing wheat flour with white water lily seed flour (20, 30, 40, 60, 80 & 100%) were prepared. The organoleptic attributes; colour, odour, taste, texture, sweetness and overall acceptability were evaluated on a Hedonic scale (7 – points) using an untrained panel. Proximate composition of Olu seeds included moisture 12.04 ± 0.06%, ash 0.54 ± 0.04%, fat 0.46 ± 0.05%, crude protein 2.35 ± 0.04%, crude fibre 0.58 ± 0.05% and carbohydrates 84.03 ± 06%. The results showed that except for odour and texture, all the other sensory attributes of 30% substitution were scored as like slightly (5) or sometimes more acceptable than the control. However, the cookies with 40% and higher than 40% olu seed flour formulations were less acceptable than 30% formulation in all sensory attributes. According to the Friedman test, there was a significant difference of cookies in terms of colour, taste, sweetness and overall acceptability (p = 0.05).*

Keywords*: Cookies, Nymphaea pubescens Willd, Olu seed, Olu flour, white water lily*

INTRODUCTION

Exploring and expanding the use of available local food sources are on the increase because of consumer demand and research interest. *Olu* (white water lily or hairy water lily), *Nymphaea pubescens Willd*, is commonly found in shallow lakes and ponds in Sri Lanka. The plant is distributed throughout the island and abundant in the dry zone. The Districts include Anuradhapura, Polonnaruwa, Matale, Kurunegala, Hambanthota, Ampara and Jaffna (Dassanyake, 1996). The white water lily plant is reported in temperate and tropical Asia (Deepthi and Indika, 2007; Deepthi and Kapila, 2011; Guruge *et al*., 2013; Guruge, 2014).

This plant is common in Bangladesh, India, Sri Lanka, Yunnan, Taiwan, Philippines, Cambodia, Laos, Myanmar, Thailand, Vietnam, Indonesia and Malaysia. It is also found in North-Eastern Australia and Papua New Guinea (Jayaweera, 1982; Dassanyake, 1996). The Genus *Nymphaeceae* has been used as a medicinal plant since ancient times (Jayaweera, 1982; Dassanyake, 1996; Shajeela *et al.*, 2012; Tunan, 2012). Phytochemicals, especially

[1] Department of Food Science & Technology, Faculty of Agriculture, University of Peradeniya,, Sri Lanka
[*] Corresponding author: pcarampath@gmail.com

alkaloids and glycosides are reported to be rich in the plant (Jayaweera, 1982). In addition, studies revealed that the seed extract contains terpenoids (triterpenoids, steroids and saponins), flavonoids, tannins (Jayaweera, 1982; Admin, 2009). The *Olu* seeds are a potential source of food and a raw material for the food industry. The plant is not cultivated commercially as a food ingredient (Admin, 2009). The utilization and application of seeds and seed flour are yet to be investigated experimentally.

White water lily seeds are possessing antibacterial properties and highly prescribed for the diabetic patients (Jayaweera, 1982; Admin, 2009). The boiled seeds are consumed as a food source since ancient times (Jayaweera, 1982; Dassanyake, 1996). White water lily seed flour is used in various food items such as *roti* or *pittu* (Sri Lanka) and bread (China and East Indies) (Jayaweera, 1982).

Urbanization and busy lifestyle especially among working women, prompt consumption of snack foods, and this trend has been increased in the recent past. Therefore, development of nutritious, flavoured and coloured snack foods is on the increase in the food industry. Accordingly, cookies, a food product in between a biscuit and a snack, became popular among the youth and adults. Due to low manufacturing cost, convenience, long shelf-life and the ability to serve as a vehicle for important nutrients, it gained popularity. In many countries, cookies are prepared with fortified or composite flour to increase its nutritive value. (Noor Aziah *et al.*, 2012).

The objective of the present research study was to determine the sensory attributes of cookies prepared with white water lily seed flour as a proportional substitute for wheat flour.

METHODOLOGY

The white water lily (*Nymphaea pubescens Willd*) seeds were purchased from Anuradhapura District. Wheat flour and margarine were purchased from the super market in Kandy.

Composition Analysis

The proximate composition; moisture, ash, crude fat, crude fibre and crude protein were analyzed using the methods described by AOAC (2000). Nitrogen content was determined by Kjeldhal method. Protein content was determined by multiplying nitrogen content (%) by the factor of 6.25. Carbohydrate content was calculated by the weight difference.

Moisture

Three stainless steel dishes were thoroughly washed and dried in a laboratory oven at 100 ^{o}C for 30 min and allowed to cool in a desiccators. After cooling, weights were recorded (W1). Then, around 5.0 g of the finely ground seed samples were weighed into metal cans and weighed (W2). The moisture cans were placed in the oven and dried at 100±5 ^{o}C until a constant weight was obtained (W3).

Moisture % = (W2 – W3) / (W2 – W1) x 100

Ash Content

About 5.0 g of finely ground dried sample was weighed into a crucible and incinerated at 550 ^{o}C in a muffle furnace until white colour ash was obtained. The ash was cooled in a desiccator and weighed.

Ash % = (Wt. of ash / Wt. of the sample) x 100

Crude Fat content

Approximately 10.0 g of sample was weighed accurately into the labelled thimbles. The dried boiling flasks filled with 300 ml of petroleum ether (boiling point 40 - 60 ^{o}C). The extraction thimbles were plugged tightly with cotton wool. After that, the Soxhlet apparatus was assembled and allowed to reflux for 5 h. The thimble was removed with care and petroleum ether collected was drained into dried pre-weighed evaporating dishes. The solvent was evaporated on a water bath and dried in dishes at 105 – 110 ^{o}C for 1 h, cooled in desiccators and weighed the sample.

Fat % = (Wt. of fat /Wt. of sample) x 100

Crude Fibre Content

About 2.5 g sample was boiled under reflex for 30 min with 200 ml solution containing 1.25 % H_2SO_4. The solution was filtered through a Gooch filter crucible under suction. After filtration, the samples were washed with boiled water until the acid is completely removed. Then, the residue was transferred and boiled under reflux for another 30 min with 200 ml of solution containing 1.25 % NaOH. The residue after filtration was washed with boiled distilled water, dried at 100 ^{o}C for 2 h in an oven, cooled and weighed. Then the crucible was heated in the muffle furnace at 550 ^{o}C for 1 h.

Crude fibre % = (Wt. after drying - Wt. After ashing) / Wt. of sample) x 100

Crude Protein Content

Crude Nitrogen was determined by Kjeldhal method.
Nitrogen % = $Vs–V_B$ x 0.0014 x100 / W

Where,
Vs = Volume (ml) of N/10 H_2SO_4 acid required to titrate sample;
V_B = Volume (ml) of N/10 H_2SO_4 acid required to titrate the blank sample;
W=Weight of sample (g).
Then, percentage crude protein in the sample was calculated from the % Nitrogen as:
Crude protein % = Nitrogen % x F
Where,
F (conversion factor) = 6.25.

Carbohydrate content

The carbohydrate content was determined as follows.
Carbohydrate % = 100 – (% moisture +% crude fibre + % protein + % fat + % ash).

Preparation of Cookies

The White water lily flour seeds were washed, de-stoned, drained, sun dried (2 h) followed by drying in a tray drier at 80 ± 2 °C. Then dried seeds were ground using laboratory scale grinder and O*lu* flour was sieved (No 30 mesh). Wheat flour used for mixing in making cookies was also sieved.

Basic ingredients used in cookie formulation (w/w) were flour 51.3%, margarine 17.9%, sugar 25.6%, egg white 4.7%, baking powder 0.5% and vanilla (5 ml per 500 g flour). The treatments, levels of substitution of wheat flour with *Olu* flour were 20, 30, 40, 60, 80 and 100% in cookie formulation. Cookie size, 4 cm diameter was maintained using an evenly flattered dough sheet. The cookies were baked in a bakery oven (180 ± 2 °C) for 20-30 min until the edges appeared golden brown. Baked cookies were cooled before packing in double layer polythene bags (gauge 300) and thermally sealed.

Sensory Evaluation

The sensory evaluation was conducted using a 7 - points Hedonic scale (1 Dislike extremely, 7 Like extremely). Sensory attributes were colour, odour, taste, texture, sweetness, and overall acceptability. Untrained fifty panellists, aged between 18 to 50 years participated for the sensory test. The experimental design was the complete randomized block design and data was analysed using Friedman test.

RESULTS AND DISCUSSION

Composition of O*lu* seeds

Proximate composition of O*lu* seeds was determined in triplicates. Moisture content 12.04%, ash 0.54%, fat 0.46%, crude protein 2.35%, crude fibre 0.58% and carbohydrate 84% were determined (table 1).

Table 1. Composition of white water lily (*Nymphaea pubescens Willd.*) seeds

Constituent (%)	Mean ± SD
Moisture	12.04 ± 0.06
Ash	0.54 ± 0.04
Fat	0.46 ± 0.05
Crude Protein	2.35 ± 0.04
Crude Fibre	0.58 ± 0.05
Carbohydrate	84.03 ± 0.06

A photograph of water lily seed flour incorporated cookies is given in Fig. 1. Cookies prepared with different concentrations of O*lu* seed flour have shown slight variation in cookie colour as shown in the Fig. 1.

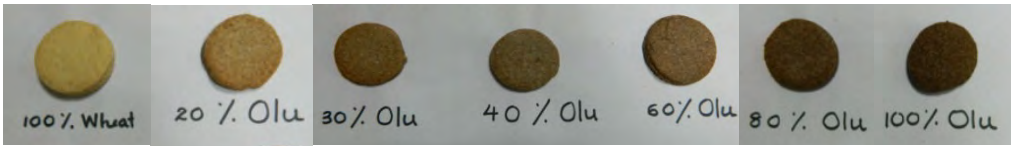

Fig. 1. *Olu* flour incorporated cookies

Sensory Evaluation

In the sensory evaluation, the mean scores of colour in 30 % incorporated cookies was 5.7 ± 1.3, while all the other treatments scored a lower mean score than the control (5.5 ± 1.7). However the incorporation of O*lu* seed flour at high percentages, i.e. above 40%, the mean scores for colour were decreased to neither like nor dislike range (Table 2). Odour mean scores of 20% O*lu* flour cookies was as similar as the control. However, result showed that odour mean scores were reduced in 30% O*lu* flour treatment. However after 30%, the mean scores were increased at 40-60% incorporation of *Olu* flour. The mean scores has been decreased after 60% incorporation. This may be due to unaccceptable aroma at higer level of *olu* seed flour incorporation.

Table 2. The mean scores of sensory attributes

Olu **flour (%)**	**Colour**	**Odour**	**Taste**	**Texture**	**Sweetness**	**Overall acceptability**
0	5.5±1.7	4.9±1.8	5.2±1.4	4.7±1.7	5.0±1.7	5.2±1.7
20	4.7±1.4	4.9±1.5	4.8±1.5	4.6±1.4	4.8±1.5	4.9±1.4
30	5.7±1.3	4.4±1.4	5.1±1.5	4.8±1.5	5.2±1.4	5.3±1.3
40	5.1±1.1	4.9±1.3	4.9±1.2	4.5±1.3	4.9±1.5	4.8±1.2
60	4.8±1.5	4.7±1.4	4.9±1.4	4.5±1.3	4.8±1.5	4.8±1.3
80	4.3±1.7	4.4±1.6	4.5±1.7	4.7±1.4	4.6±1.7	4.2±1.6
100	4.0±1.7	4.2±1.7	4.1±1.5	4.5±1.6	4.1±1.8	3.9±1.6

(Mean score ± Standard Deviation)

Mean scores of taste at 30% treatment of O*lu* seed flour was 5.1 ±1.5 (like slightly), and the score was similar to the control (5.2 ±1.4). While other treatments were reported as 4 (neither like nor dislike). Mean scores of texture was not considerably varied in all treatments (4, neither like nor dislike).

The mean scores of sweetness were identified as like slightly (score 5) in 30% O*lu* flour incorporated cookies and the control, while all the other treatments were scored as neither like nor dislike (Table 2). This may be due to the masking effect of sweetness at higher percentages of O*lu* seed flour incorporation into cookies. The overall acceptability of taste at 30% incorporation of O*lu* seed flour was 5.3 ±1.3 (like slightly), and the score was similar to the control samples (5.2 ±1.7). All other treatments were reported with mean scores lower than 5. The result revealed that 30% O*lu* seed flour incorporation is the best level to substitute wheat flour in formulation of cookies.

Table 3. Probability (p) values of the sensory attributes

Attribute	p value
Colour	0.000
Odour	0.059
Taste	0.000
Texture	0.564
Sweetness	0.001
Overall acceptability	0.000

Probability (p) values (α=0.05) of the sensory attributes among the treatments is given in Table 3 (Freidman test, MINITAB 17). There was no significant difference between the treatments on odour and texture among all treatemnets ($p>0.05$). In contrast, the p values of colour, taste, sweetness and overall acceptibility among the all treatements were significantly different ($p<0.05$) at α=0.05 significant level. Therefore, 30% *Olu* seed flour incorporated cookie formulation was the best among 20, 30, 40, 60, 80 and 100% treatments based on the sensory evaluation.

CONCLUSION

Formulations of cookies with *Olu* seed flour, 40% and above 40% were scored as neither like nor dislike (Hedonic scale, 7 points) for colour, odour, taste, sweetness and overall acceptability. The cookies with 30% O*lu* seed flour formulation were scored as like slightly (5) for all the sensory attributes except for odour and texture. Therefore, 30% incorporation of O*lu* seed flour substituting wheat flour is acceptable for the formulation of cookies.

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