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Preparation and Quality Evaluation of Rice Based Cookies Fortified with Different Herbs

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ABSTRACT

Paddy production of Sri Lanka has reached to its self sufficiency within last few years generating an excess harvest even though rice has been consumed as a staple food. Rice flour is the most suitable cereal grain flour to prepare foods for celiac patients due to presence of easily digested carbohydrates and absence of gliadin. Three different cookie formulations (F_1, F_2, F_3) were tested by changing the ingredient ratio of fat, sugar and desiccated coconut based on a constant quantity of rice flour and the best formulation was selected by sensory evaluation. Mixture of herbal powder was prepared by mixing dried and powdered herbs of 'Karapincha' (Murrayakoenigii), 'Iramusu' (Hemidesmusindicus) and 'Hathawariya' (Asparagus gonoclados) in 1:1:1 ratio. The most preferred cookie formula was fortified with pre-prepared mixture of herbal powder in the percentages of 1.0%, 1.5% and 2.0% developing three treatments such as F_4, F_5 and F_6 respectively. The most accepted herbal cookie formulation was selected by sensory evaluation using five point hedonic scale. Selected formulation was subjected to physico-chemical analysis for fiber, protein, fat, ash and moisture contents. The nonparametric data were analyzed using Friedman test with Minitab statistical package. According to the results of the sensory evaluation, F_2 was identified as the most preferred formulation which had highest overall acceptability [Rice flour: 300g, Fat: 175g, Sugar: 125g, Desiccated coconut: 50g]. Highest overall acceptability for fortified cookie was recorded in F_5 which contained 1.5% of mixture of herbal powder with 2.21±0.12% fiber, 6.72±0.38% protein, 26.65±0.82% fat, 0.68±0.07% ash and 5.85±0.11% moisture. Diameter of the cookies was 34.2±2.0 mm and thickness was 9.4±1.0 mm with 3.63±0.61spread factor.

Keywords: *Cookies, Fortification, Herbs, Quality analysis, Rice flour*

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1 Introduction

Paddy production of Sri Lanka for 2014/2015 'Maha' season was 28.77 million MT which was a 29% increase compared to 2013/2014 'Maha' season and reached its self-sufficiency within last few years generating a surplus production due to high yielding varieties and increase of cultivated land area (Department of Census and Statistics, 2015). Rice is the staple food of Sri Lankans and it provides 45% calorie and 40% total protein requirement of an average Sri Lankan (Fari *et al.*, 2010). Sri Lanka spent around 86.8 million US dollars in first quarter of the year 2015 for importation of wheat and maize (Central Bank of Sri Lanka, 2015). Rice flour based food items can be introduced to the market as substitute for wheat flour products. Rice flour possesses unique attributes such as bland taste, white colour, ease of digestion and hypoallergenic properties (Gallagher, 2009). One in 300 births in world can not eat gluten containing food items such as wheat, barley and rye due to celiac disease which caused by genetic intolerance to gluten (Maghaydah *et al.*, 2013). Rice flour is the suitable cereal grain flour for preparing foods for celiac patients due to presence of easily digested carbohydrates and absence of gluten (Man *et al.*, 2014). Wheat flour, fat and sugar are the three main ingredients of common wheat flour biscuits and different combinations has resulted full range of biscuit products including crackers and cookies. Other flours can be used to replace wheat flour in preparation of gluten-free biscuits since gluten structure is not necessary in most biscuit products (Hui *et al.*, 2006). The texture of baked biscuits depends on starch gelatinization and super cooled sugar rather than a protein starch structure (Gallagher, 2009). The protein in rice is rich with lysine compared to wheat protein due to rice possesses better amino acid balance. Therefore quality of rice protein is better than wheat protein (Friedman, 1996). Rice flour is rich with some minerals such as iron, phosphorous, potassium and magnesium. The degree of removal of outer bran layer causes a loss of proteins, fiber, vitamin and minerals (Arendt & Bello, 2011). Processing of rice flour with minimum removal of bran layer can elevates the nutritional level of flour. 'Karapincha' (*Murrayakoenigii*), 'Iramusu' (*Hemidesmusindicus*) and 'Hathawariya' (*Asparagus gonoclados*) are some common important medicinal plants found in Sri Lanka. 'Karapincha'or Curry leaf is a common edible leaf for culinary purposes as well as for medicinal uses. 'Iramusu' is a herb which has edible leaves and has ability to purify blood. 'Hathavariya' leaves are edible and have an ability to facilitate weight gain (Institute of Ayurveda, 2015). Hence this study was conducted to develop a rice based fortified cookie using above herbs and evaluate the product quality.

2 Materials and Methods

Pre-gelatinized rice flour was used to prepare cookie. Rice flour, margarine, sugar, desiccated coconut, baking powder, salt and eggs were purchased from the super market. Fresh plant materials of 'Karapincha', 'Iramusu' and 'Hathawariya' were purchased from local market. Leaves were picked, washed and drained then dried using laboratory scale air oven at 50 °C until moisture content reduced to 10% (w/b). Dried leaves were ground separately using a laboratory scale grinder to obtain powder. Mixture of herbal powder was prepared by mixing separately dried and powdered herbs of 'Karapincha', 'Iramusu' and 'Hathawariya' in 1:1:1 ratio.

2.1 Preparation of rice cookies

Three different rice cookie formulations (F_1, F_2, F_3) were prepared without adding herbs by changing the composition of different ingredients such as margarine, sugar and desiccated coconut as shown in table 01. Rice flour, baking powder and desiccated coconut were mixed together and kept aside before add. Then margarine, salt and sugar were mixed until sugar is dissolved using electric hand mixer. Egg was added to above mixture and mixing was continued until mixture became creamy. After that, premixed mixture of rice flour, baking powder and desiccated coconut was gradually added to margarine mixture and mixing was continued. Finally, mixture was kneaded well by hand to prepare uniform dough. Final dough was kept in a stainless steel bowl for 15 min at room temperature (30±1 °C) for resting. After resting, dough was cut and shaped using a mould making cookies. Cookies were baked using laboratory scale electric oven at 180 °C for 20 min. Most preferred rice cookie formula out of three formulations (F_1, F_2, F_3) was selected according to the results of sensory evaluation to fortify with different herbs.

Table.1: Ingredients of rice cookies

Ingredients	Prototype cookie formulations		
	F_1	F_2	F_3
Rice flour (g)	300	300	300
Margarine (g)	150	175	200
Sugar (g)	100	125	150
Desiccated coconut (g)	25	50	75
Baking powder (g)	6	6	6
Salt (g)	3	3	3
Egg	1	1	1

2.2 Preparation of herbal rice cookies

According to the results of sensory evaluation, F_2 was selected as the best treatment which had the highest value in mean score for overall acceptability. Herbal rice cookies were prepared adding the mixture of herbal powder in three different ratios to F_2 formulation as shown in table 1 and followed the same processing method for preparation of rice cookies as shown in figure 1.

Table.2: Ingredients of fortified herbal cookies

Ingredients	Herbal cookie formulations		
	F_4	F_5	F_6
Herbal powder mixture %	**1%**	**1.5%**	**2%**
Rice flour (g)	300	300	300
Margarine (g)	175	175	175
Sugar (g)	125	125	125
Desiccated coconut (g)	50	50	50
Baking powder (g)	6	6	6
Salt (g)	3	3	3
Egg	1	1	1
Herbal powder mixture(g)	3.0	4.5	6.0

2.3 Product quality evaluation

2.3.1 Sensory evaluation

Two separate sensory evaluations were carried out to find the acceptability of rice cookie formulations (F_1, F_2, F_3) and fortified cookie formulations (F_4, F_5, F_6). Three different formulations of each experiment were compared separately for colour, aroma, flavor, crispiness and overall acceptability by thirty untrained panelists using five point hedonic scale (1-extremely dislike, 5-extremely like).

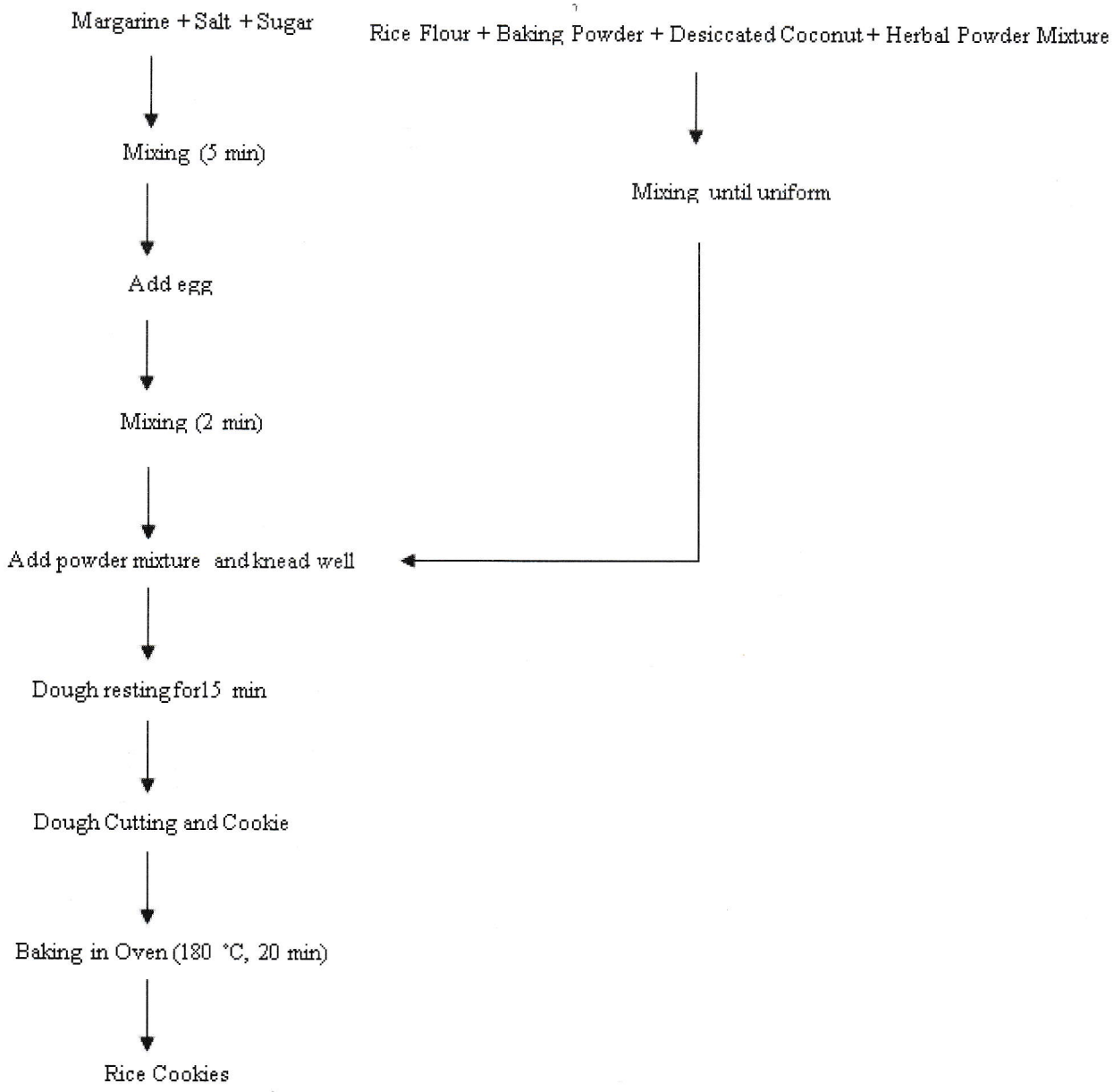

Figure 1: Flow diagram for preparation of rice based herbal cookies

2.3.2 Proximate analysis

Selected formulation (F_5) was subjected to physico-chemical analysis for fat, protein, fiber and ash contents described in AOAC (2000). Moisture content was determined oven dry method at 105 °C until get constant weight (Sri Lanka Standard 251:1991)

2.3.3 Spread Factor (SF)

Width (W) of five baked cookies was measured by placing five cookies edge to edge. The cookies were rotated for 90° angle and reading was duplicated. Thickness (T) of the baked cookies was measured by placing five cookies stacking on top of one another, then restacked in different order and average thickness was measured. Spread factor (SF) was determined dividing width by thickness (Maghaydah *et al.*, 2013).

3 Statistical analysis

The nonparametric data were analyzed using Friedman test with Minitab statistical package and treatment means were compared at $p<0.05$ using multiple comparison procedure.

4 Results and Discussion

The results of the sensory evaluation for formulated rice cookies are shown in figure 2. Among three formulations,F_2 recorded the highest mean score for all attributes. Mean scores for colour of all formulations had more than 4 while F_3 formulation recorded the lowest score. This may be due to addition of sugar than other formulations which caused excess browning because of caramelization at higher temperature (180 °C) followed by Millard reaction during cooling (Varzakas, 2012). In all treatments, the aroma of cookies made with rice flour had mean scores less than 4.0 and all values were not significantly different ($p<0.05$). F_2 formulation had highest mean score for taste which was not significantly different with F_3 also due to addition of more fat and sugar. F_1 had lowest score for crispiness while rest two formulations were not significantly different ($p<0.05$) may be due to addition of more sugar which made a higher crispiness. Among three formulations, F_2 was selected as most acceptable formula which had highest mean scores for overall acceptability.

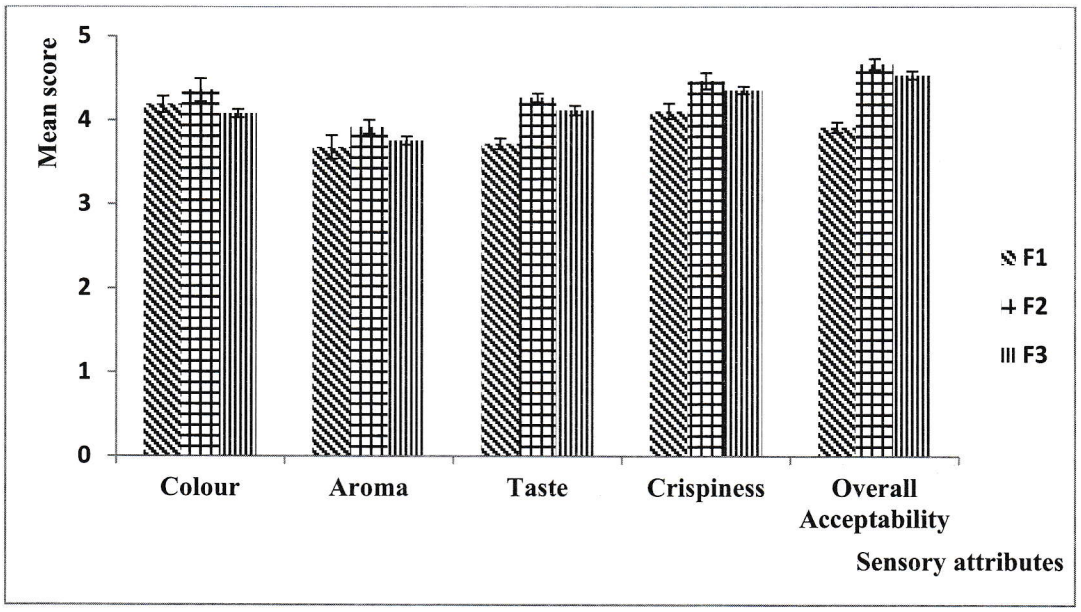

Figure 2: Mean scores for sensory attributes of three rice cookie formulations

The mean sensory scores of three different herbal cookie formulations (F_4, F_5, F_6) for colour, aroma, taste, crispiness and overall acceptability are shown in figure 03. Mean scores for colour was decreased from 4.21 to 3.72 in F_4 and F_6 respectively with the increase of herbal powder percentage from 0.5 % to 1.5%.Highest acceptable mean score for colour was recorded in F_4 which was not significantly different ($p<0.05$) with F_5. Colour of herbal cookies was turned into dark green with the increase of powder percentage that gave the lower mean score for F_6. Treatment F_5 had highest mean values for aroma and taste which were significantly different ($p<0.05$) with F_4 and F_6. Aroma is an important attribute of baked food products which sense before taste. F_5 formulation with 1.5% herbal powder mixture was identified as the most acceptable formulation for aroma and taste. Mean scores for crispiness decreased with the increase of herbal powder percentage. Fibrous texture was recorded in F_6 formulation, with the addition of 2.0% herbal powder which was highly rejected by most of the panelists. F_5 showed highest overall acceptability value which was significantly different ($p<0.05$) with other two formulations. According to results of the sensory evaluation, F_5 was selected as most accepted herbal cookie formulation.

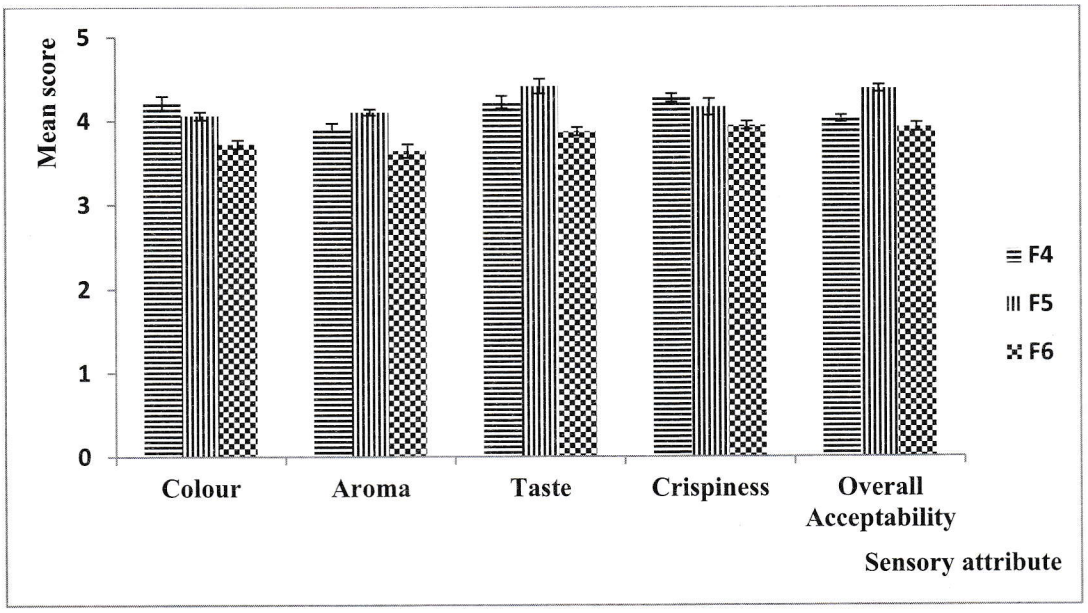

Figure 3: Mean scores for sensory attributes of herbal rice based cookie formulations

The selected rice based herbal cookie formulation (F_5) was subjected to proximate analysis for fiber, protein, fat, ash and moisture contents. Fiber content of F_5 (2.21%±0.12) was about two times higher than the fiber content of cookies made up of 100% wheat flour (1.23%) according to the results obtained by Maghaydah *et al.*, (2013). Consumer interest for fiber rich diets has increased due to health benefits. Fresh banana contain 1.7 and Grapes contain 1.2 (g/100g of total edible portion) of dietary fiber (Cho *et al*, 1999) which are lower values than developed rice herbal cookies. Protein content of F_5 was 6.72% which is a similar value in Mung bean cookie (6.55 %) according to the results of Aziah *et al.*, (2012).Fortified bakery products are demanded by the consumers due to increased awareness of healthy and functional food items (Mishra *et al.*, 2012).

High fat content was recorded byrice based herbal cookies (26.65%)compared to wheat flour cookies having 16% (Rai *et al.*, 2012) while wheat flour cookie prepared by Aziah *et al.*, (2012) recorded 24.43 % of fat content which is compatible value with rice based herbal cookies. According to the results obtained, moisture content of baked herbal cookie was 5.85% and it was compatible with rice bran supplemented cookies prepared by Younas *et al.*, (2011) with 5.13 % moisture content. Maximum allowed moisture content of cookies is 8.0 % according to the Sri Lanka Standard 251:1991-Specification for biscuits. Developed herbal rice cookies conform the Sri Lanka Standard specification for cookies since cookie moisture content was 5.85%. Ash content of fortified cookie was 0.68 % which was a lower value than values obtained for wheat based cookies (0.82%), Mung bean cookies (1.28%) and chickpea cookies (1.12%) (Aziah *et al.*, 2012).

Table 3: Proximate analysis of F5 formulation

Parameter	Value
Fiber %	2.21±0.12
Protein %	6.72±0.38
Fat %	26.65±0.82
Ash %	0.68±0.07
Moisture %	5.85±0.11

Data represented as mean±SD (*n=3*)

Spread factor of herbal cookie is shown in table 4. Spread factor of herbal cookies was 3.63 while the

value for cookie made with 100% wheat flour was 5.89 (Rai *et al.*, 2014). Cookie spread factor represents a ratio of diameter to height. Cookie dough viscosity is influenced by protein content and gluten protein in wheat flour will form a web in cookie dough when heated. The formation of continuous gluten web increases the viscosity and stops the flow of cookie dough (Aziah *et al.*, 2012). Sugar and vegetable shortening exert a great influence on spreading and viscosity helps to prepare cookies in reduced thickness. According to the results of Montes *et al.*, (2015), the cookie made with rice bran which had higher fiber content had spread factor of 1.09. Developed herbal cookie recorded a low spread factor (3.63) than wheat cookie (5.89), even though rice flour is free of gluten, may be due to addition of herbal powder able to reduce the viscosity.

Table 4: Diameter, thickness and spread factor of herbal cookies (F5)

	Diameter (mm)	**Thickness (mm)**	**Spread factor**
F_5	34.2±2.0	9.4±1.0	3.63±0.61

Data represented as mean±SD ($n=3$)

5 Conclusion

100% rice flour based cookies can be prepared with acceptable sensory qualities. Rice based cookies fortified with1.5% of herbal ('Karapincha', 'Iramusu' and 'Hathawariya') powder mixture was the most preferred herbal cookies.

6 References

AOAC.(2000).Official methods of analysis (17th ed). Association of Official Analytical Chemists,Washington,DC.

Arendt, E.K and Bello, F.D. (2011). Gluten free cereal products and beverages. Academicmpress.USA.

Aziah, N.A.A., Noor, M.A.Y. and Ho, L.H (2012) Physicochemical and organoleptic properties of cookies incorporated with legume flour. International Food Research Journal.19(4):1539-1543.

CentralBankofSriLanka:http://www.cbsl.gov.lk/pics_n_docs/02_prs/_docs/press/press_20150625ea.pdf [Accessed 2015-11-23]

Cho, S.S, Prosky, L and Dreher, M (Eds). (1999). Complex carbohydrates in foods.Marcel Dekker.NewYork.p 334.

Department of Census and Statistics. (2015). Paddy statistics-2014/2015 Maha season.http://www.statistics.gov.lk/agriculture/Paddy%20Statistics/PaddyStatsPages/PADDY%20STATISTICS%202014-15%20MAHA.pdf [Accessed 2015-11-30]

Fari, M.J.M., Rajapaksa, D. and Ranaweera, K.K.D.S.(2010) .Effect of rice variety on rice based composite flour bread quality.Tropical agricultural research.21(2):157-167.

Friedman, M.(1996). Nutritional value of proteins from different food sources: A review. Journal of agricultural and food chemistry.44:06-29

.

Gallagher, E (ed).(2009). Gluten-free food science and technology. Wiley-Blackwell publishing. United Kingdom.p. 107.

Hui, Y.H, Corke, H., Nip, W and Cross, N.(eds). (2006). Bakery products science and technology. Blackwell publishing.USA.p.484.

Institute of Ayurveda Sri Lanka. Ayurvedic medicinal plants of Sri Lanka. http://www.instituteofayurveda.org/plants/index.php [Accessed 2015-10-19]

Maghaydah, S., Hussain, S.A., Ajo, R., Obeidat, B and Tawalbeh, Y. (2013). Enhancing the nutritional value of gluten-free cookies with inulin.Advanced Journal of Food Science and Technology. 5(7):866-870.

Man, S., Paucean, A., Muste, S and Pop, A.(2014).Studies on the formation and quality characteristics of gluten free muffins. Journal of agroalimentary process and technologies. 20(2):122-127.

Mishra, N and Chandra, R.(2012). Development of functional biscuit from soy flour and rice bran. International Journal of Agricultural and Food Science 2(1):14-20.

Montes, S. de.S., Rodrigues, L.M., Cardoso, R. de. C.V., Camilloto, G.P. and Cruz, R.S. (2015). Tapioca and rice flour cookies: Technological , nutritional and sensory properties.Cienc.Agrotec.39(5):514-522.

Rai, S., Kaur, A. and Singh, B. (2014). Quality characteristics of gluten free cookies prepared from different flour combinations. Journal of Food Science and Technology.51(4):785-789.

Sri Lanka Standard Institution. (1991).Sri Lanka Standard 251:1991.Specification for biscuits (1st Revision). Colombo 03, Sri Lanka.

Varzakas, T., Labropoulos, A. and Anestis, S. (eds.). (2012). Sweeteners: Nutritional aspects, applications and production technology.CRCpress.NewYork.p 217-218.

Younas, A., Bhatti, M.S., Ahmed, A. and Randhawa, M.A.(2011). Effect of rice bran supplementation on cookie baking quality. Pakistan journal of agricultural science. 48(2):129-134.