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Assessment of antinutritional factors of lentil based RTC foods as influenced by domestic processing

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ABSTRACT

Pulses are imperative sources of protein, carbohydrates, dietary fibre and minerals inspired worldwide. Lentils are one of the most chief protein loaded pulses, botanically classified as of high nutritional quality. Lentil cook quickly compared to other pulses making them more desirable for human consumption. Antinutrional factors in lentils will bound the nutrients, thereby reducing the nutritional value. Domestic processing and cooking methods are recognized to diminish the antinutritional factors and progress the nutritive value of lentil. Hence, the present work was carried out to develop and reduce the antinutritional factors in lentil based traditional RTC foods such as Pongal, Bisibellabath and Kheer and Sambar from Canadian lentil varieties. The results obtained from this study that phytic acid content was considerably lowered in prepared traditional products. By applying heat, anti-nutritional factors such as trypsin inhibitors and tannin were almost removed. Demand to healthy RTC products is more nowadays because of buyers curiosity to new products and health concern. Hence, the results provide some understanding of the formulated lentil based RTC convenience foods had great potential to provide to population with highly nutritional, healthy foods.

Key Words : Lentil, Anti-nutritional factors, RTC foods, Domestic processing

INTRODUCTION

Legumes are broad diversity of crops that are included in flowering plants producing seeds in pods that are often cultured for food and feeds. Legumes ranked as 3rd largest family of flowering plants having more than 19500 species and over 750 genera (Lewis *et al.,* 2016). The term legume has been mainly derived from Latin word 'legumen' which mean the seeds that are harvested in pods. In some regions, legumes are considered as pulses, pea, or member of bean family. The edible seeds of legumes play an important role in diet providing essential nutrients with medium to high calories value (Aykroyd and Doughty, 1982). Pulses constitute one of the richest sources of including valuable but incompletely balance protein, particularly in vegetarian's diet (Ghadge *et al.,* 2008). Lentil as a pulse crop, are a very important component of tropical agriculture and provide a highly nutritious and protein rich food. Lentil is one the best and cheapest sources of vegetable protein. Although lentils are considered to be one of the most nutritious pulses, they contain several antinutritional factors such as phytic acid, trypsin inhibitors and tannin which could limit their consumption (Salunkhe and Kadam, 1989).

Removal of undesirable components is essential to improve the nutritional quality of legumes and effectively utilize their full potential as human food. It is widely accepted that simple and inexpensive processing techniques are an effective method of achieving desirable changes in the composition of seeds. Different processing methods includes soaking, cooking, fermentation and germination improve the quality of legumes because of

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the removal of some antinutritional factors. In many instances, usage of only one method may not affect the desired removal of antinutritional compounds and combination of two or more methods is required.

Convenience foods and traditional foods have played a vital role in the life of human being since antiquity as they reduce varying steps involved in the preparation upto cooking. The Indian Ready to Cook (RTC) food segment has emerged from its early days of being a fringe alternative to home cooked meal or to eating out. A larger proportion of urban consumers are experimenting with RTE/RTC foods on a more frequent basis with the top two value propositions being 'saves time' and 'tastes good'. Now, the time is to provide better food processing and its marketing infrastructure for Indian industries to serve good quality and safest processed food like Ready to Cook and Ready to Eat food.

The aim of the present work was to develop the lentil based RTC foods such as Pongal, Bisibellabath and Kheer and sambar from Canadian lentil varieties and to enhance their nutrients bioavailability with the removal of the antinutritional factors and make it edible safe protein sources for global consumption.

METHODOLOGY

Small green lentil and large green lentil as research material were supplied from University of Saskatchewan, Canada. Rice, Red gram dhal, green gram dhal and black gram dhal were purchased from local departmental stores in Madurai, Tamil Nadu. Miscellaneous items were purchased from the local departmental stores, Madurai.

Standardization of Lentil Based Ready to Cook Food Products:

Drying of Rice:

About 500 g of raw rice and boiled rice was cleaned, washed and soaked in 1000ml water for half an hour and cooked partially for 12 minutes at 110°C and checked for its moisture content separately. The cooked rice was laid evenly in cabinet trays. Convection drying method was adopted to dry the rice at 65°C at air velocity of 2.0 meter/sec for about one hour and 42 minutes. The moisture content of the dehydrated rice of each category was estimated and this was repeated thrice to optimize the percentage moisture content to be retained in RTC raw rice and boiled rice.

Drying of Pulses:

About 200 g of pulses of each category was cleaned and washed, and cooked with 200 ml of water at 110°C. Cooked dhal was dried in the convection drier. And the experiment was repeated thrice to optimize the percentage of moisture content to be retained in all categories of RTC pulses.

Drying of Other Ingredients:

Onions, tomato, carrot, beans and other ingredients depending upon the product were cleaned, washed and chopped and seasoned with oil/ghee. These were dried by using Convection drying method.

RTC Pongal:

Semi cooked and dehydrated raw rice and dhal, roasted cumins, pepper and salt were mixed together in different proportions and is presented in the given Table 1.

Table 1 : Development of Ready to Cook *Pongal*

Ingredients	Level of incorporation (g)			
	T_1	T_2	T_3	T_4
Raw rice	500	500	500	500
Green gram	250	175	125	-
Green lentil	-	75	125	250
Cumin seeds	10	10	10	10
Black pepper	10	10	10	10
Cashew nuts	15	15	15	15
Curry leaves	5	5	5	5

T_1 - 100 % Green gram (control)
T_2 - 70 % Green gram and 30% Green lentil
T_3 - 50 % Green gram and 50% Green lentil
T_4 - 100 % Green lentil

Based on the sensory evaluation of the *pongal* prepared from different proportions of control (green gram) and experimental pulses (green lentils) , acceptable level of use of lentil in the place of green gram was optimized and used to standardize the *pongal.*

Method of Preparation:

- Add water thrice the amount of RTC *Pongal*
- Pressure cook for 10 mins
- Serve hot with ghee (Optional)

RTC Bisibelabhath:

Bisibelabath is a main course dish prepared by using boiled rice, red gram and vegetables mainly consumed in Karnataka, Tamil Nadu and Andhra Pradesh. The

formula for preparing RTC *Bisibelabath* by using precooked and dehydrated boiled rice, red gram dhal and lentils in different proportions is given in Table 2.

Table 2 : Development of Ready to Cook *Bisibelabath*

Ingredients	Level of incorporation (g)			
	T_1	T_2	T_3	T_4
Rice	500	500	500	500
Red gram	200	100	50	-
Green lentil	-	100	150	200
Onion (small)	20	20	20	20
Tomato	20	20	20	20
Carrot	20	20	20	20
Beans	20	20	20	20
Chilly powder	40	40	40	40
Tamarind paste	10	10	10	10
Oil	30	30	30	30

T_1 – 100 % Red gram (control)
T_2 – 50 % Red gram and 50% Green lentil
T_3 - 25 % Red gram and 75% Green lentil
T_4 - 100 % Green lentil

Based on the sensory evaluation of the *bisibelabath* prepared, the product prepared from 100 per cent of green lentil had received higher acceptability score and hence 100 per cent green lentil was used for preparing *bisibelabath* in the place of red gram.

Method of Preparation:

- Add water thrice the amount RTC *Bisibelabath*
- Pressure cook for 15 mins
- Serve hot with ghee (Optional)

RTC Sambar:

RTC Sambar is a dehydrated sambar mixture consisting of precooked and dehydrated dhal and precooked and dried vegetables ready for cooking. This can be cooked within 5-10 minutes. After cooking this product will be similar to vegetable stew or a broth made from red gram. This can be served along with *idli* , dosai and, rice. Using the different proportion of precooked and dried red gram and green lentil RTC *sambar* was prepared and the details are given in Table 3.

Based on the sensory evaluation of the RTC *sambar* prepared from different proportion of red gram and lentil, *sambar* from 100 per cent of lentil was highly acceptable and standardized.

Method of Preparation:

- Add 1:4 ratio of water to the content of RTC

Table 3 : Development of Ready to Cook *Sambar*

Ingredients	Level of incorporation (g)			
	T_1	T_2	T_3	T_4
Red gram	100	50	25	-
Green lentil	-	50	75	100
Onion (small)	20	20	20	20
Tomato	10	10	10	10
Carrot	10	10	10	10
Beans	10	10	10	10
Red chilli powder	20	20	20	20
Turmeric powder	3	3	3	3
Mustard	2	2	2	2
Tamarind paste	5	5	5	5

T_1 – 100 % Red gram (control)
T_2– 50 % Red gram and 50 % Green lentil
T_3 - 25 % Red gram and 75% Green lentil
T_4 - 100 % Green lentil

Sambar

- Pressure cook for 5 mins
- Serve hot with ghee (Optional)

RTC Kheer:

Precooked and dehydrated dhal, powdered sugar and milk powder were mixed in the proportion 1: 0.75: 1 and cashew nuts and raisins were roasted and added to the mixture. *Payasam* or *kheer*, is a traditional Indian dessert prepared during celebrations at home and regularly served along with the meal in hotels. But RTC kheer is a new product would be highly useful to the domestic, small and large caters and hotel industries. The formula for preparing RTC *Kheer* is given in Table 4.

Table 4 : Development of Ready to Cook *Kheer*

Ingredients	Level of incorporation (g)			
	T_1	T_3	T_4	T_5
Green gram	100	50	25	-
Green lentil	-	50	75	100
Milk	40	40	40	40
Sugar	30	30	30	30
Cashew nuts	15	15	15	15
Raisins	15	15	15	15
Cardamom	5	5	5	5

T_1 – 100 % Green gram (control)
T_2 – 50 % Green gram and 50 % Green lentil
T_3 - 25 % Green gram and 75% Green lentil
T_4 - 100 % Green lentil

The RTC *Kheer* prepared from control (green gram) and experimental pulse (green lentils) in different proportions was evaluated and the RTC *Kheer* prepared

from 100 per cent lentils was found to be highly acceptable. So the RTC *Kheer* was standardized by using 100 per cent lentils in the place of green gram.

Method of Preparation:

- Add water thrice the amount of RTC *Kheer*
- Pressure cook for 15 mins
- Serve hot.

Estimating the antinutritional factors:

Anti nutritional factors such as Phytic acid, Trypsin Inhibitor and Tannin content were analysed in the Department of Plant Science, College of Agriculture, and University of Saskatchewan, Canada. Phytic acid content was measured at 500nm by using water to zero spectrophotometer (Latta and Eskin,1980). Trypsin activity was measured at 405 nm using water to zero spectrophotometer (Page *et al*., 2000). The tannin content was determined as per the method described by Schandert (1970). Aluminium foil covers is used for packaging the lentil based food products.

Statistical analysis:

The experiment was performed using a randomized design. All data are expressed as means of trplicated experiments unless mentioned otherwise. Data were subjected to a one way analysis of variance (ANOVA), and the mean differences were compared by least standard (LCD) test.

RESULTS AND DISCUSSION

The nutritional importance of a given foodstuff in a diet is well evident, depends not only on the nutrient composition, but also on the presence of anti-nutritional factors. Hence, elimnation or inactivation of anti-nutritional factors is absolutely necessary to improve the nutritional quality of lentil and effectively utilz their full potential as human food. Table 5 shows the effect of cooking methods on antinutritional factors in lentil based RTC foods.

Antinutritional factors of boiling and pressure cooked lentil based food products

Table 5 shows the effect of processing on the antinutritional factors of boiling and pressure cooked lentil based food products.

Phytic acid (%):

Boiling and pressure cooking of lentil based food products brought about a significant reduction in the phytic acid content. The phytic acid content was 0.10 to 0.13 per cent in sambar RTC, 0.15 to 0.18 per cent in Kheer RTC, 0.23 to 0.31 per cent in Bisibellabhath RTC , 0.28 to 0.35 per cent in pongal RTC from from large and small lentil respectively. The apparent decrease observed in phytic acid content due to cooking may be attributed to the formation of insoluble complexes between phytic acid and other component.

Shinde *et al.* (1991) studied the effect of dehulling and cooking on the levels of phytate phosphorous, polyphenols and trypsin inhibitor activity of cow pea seeds. The results indicated beneficial effect of cooking in reducing the levels of phytate phosphorous, polyphenols and trypsin inhibitor activity in cow pea seeds. The antinutritional factors such as trypsin inhibitor activity, flatus compounds, phytic acid and tannin contents showed the reduction in instant adai mix samples packed in different packaging materials throughout the storage period (Bhavani, 2000). Phytate is water soluble, thus a considerable amount of phytate is removed into the

Table 5 : The effect of cooking methods on antinutritional factors in lentil based RTC foods

Name of the product	Phytic acid (%)	Trypsin Inhibitor (%)	(Tannin mg/100g)
Boiling			
Sambar RTC (large lentil)	0.10	3.78	0.29
Sambar RTC (small lentil)	0.13	3.72	0.25
Kheer RTC (large lentil)	0.15	3.52	0.21
Kheer RTC (small lentil)	0.18	3.47	0.17
Pressure cooking			
Bisibellabath RTC (large lentil) (small lentil)	0.23	3.92	0.19
Bisibellabath RTC	0.31	3.90	0.16
Pongal RTC (large lentil)	0.28	3.16	0.26
Pongal RTC (small lentil)	0.35	3.12	0.24
CD (P<0.05)	0.0352	0.01860	0.02364

soaking water. In addition, this process also enhances the action of naturally occurring phytase in legumes (Kumar *et al.,* 2010). The present investigation was found to be in agreement with the earlier studies cited.

Trypsin inhibitors (%):

The presence of trypsin inhibitors activity was observed in boiling and pressure cooked lentil based RTC food products. The values were ranged between as 3.16 to 3.92 per cent in the products prepared from large lentil and 3.12 to 3.90 per cent in small lentil based food products such as sambar, kheer, bisibellabhath and pongal. A decreasing trend of trypsin inhibitor activity was observed in the plain and spiced high protein khakras packed in polythene pouches with and without vacuum throughout the storage period of 90 days (Bhuvaneswari, 2000). Boiling and pressure cooking is popular method of cooking as it saves cooking time and conserves nutrients. The loss of antinutrients was similar either by boiling or pressure cooking except in the case of Trypsin Inhibitor Activity. Kadam and Smithard (1987) observed that cooking of presoaked winged bean in boiling water for 30 minutes was sufficient to inactivate trypsin inhibitor. Cooking for 60 minutes at 100°C was sufficient to inactivate over 90 per cent of trypsin inhibitor activity in *P. vulgaris* (Turgo *et al.,* 1990).

Tannin (mg/100g):

The tannin content of food products prepared from Canadian pulses such as sambar, kheer, bisibellabhath and pongal were ranged between 0.16 to 0.25 mg/100g from small lentil the same food products prepared from large lentil were 0.19 to 0.29 mg/100g. It was observed that the small lentil had the lowest value. In terms of human nutrition, the content of both tannins and total free phenolics are not desirable for human consumption. Whereas pytic acid reduces the bioavailability of some essential minerals, tannins inhibit the digestibility of proteins, carbohydrates and the bioavailabiltilty of vitamins such as vitamin B12 and minerals (Liener, 1994). They also decreases the activity of digestive enzymes such as trpsin, chymtrypsin lipase and α-amylase.

Conclusion:

This study indicated that traditional processing methods alter the biochemical composition of lentils. Boiling and pressure cooking is popular method of cooking as it saves cooking time and conserves nutrients. These processing method significantly decreased the levels of phytic acid, trypsin inhibitor and tannin in the prepared RTC food products by applying heat. These are simple and inexpensive processing and cooking methods, which can be followed to increase the nutritional quality of lentil products. There is a rise in the demand for foods based of traditional Indian and international recipes across different states in India and abroad. Demand to healthy foods, RTC products is emerging more nowadays because of buyers curiosity to new products and health concern. Both are recommended treatment at both domestic and industrial scales to prepare good quality lentil for human nutrition uses.

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