



Food and Agriculture
Organization of the
United Nations

MAINSTREAMING NUTRITION IN THE AGRICULTURE SECTOR IN SRI LANKA

TECHNICAL BRIEF

PULSES



INTRODUCTION & IMPORTANCE

Pulses have been a part of the diet since the beginning of farming and are consumed by people in all continents of the world. They serve as nutrient-rich food for billions of people. Although the terms 'legumes' and 'pulses' are interchangeably used, pulses are the edible parts of legumes; thus, all legumes are not termed as pulses. The United Nations General Assembly declared 2016 as the International Year of Pulses. Pulses belong to the leguminosae family. They consist of seeds that are consumed by human beings in the form of dry grains and also include peanuts and soybeans, which are considered oil crops. Pulses which include peas, beans and lentils, bear a high nutritional significance and have been an essential part of the traditional Sri Lankan diet for centuries. Cowpea, green gram,

black gram, soybean and horse gram are currently cultivated in Sri Lanka while red and yellow lentils, chickpeas and green peas are imported.



Pulses are rich in carbohydrates (55-65%) and proteins (18-25%) and serve as a rich source of carbohydrates and plant proteins (FAO, 1994). The protein content of pulses is much higher than those of cereals and other food crops. Therefore, they play a vital role in the diet of vegetarians who totally depend on plant proteins. One of the key issues of pulses is that they lack some essential amino acids, namely methionine, tryptophan and cystine.

Pulses have been recognised as an important food group in food-based dietary guidelines of countries – including Sri Lanka – and have been promoted by healthcare professionals.

Besides serving as a rich source of plant protein, pulses contain many vitamins and minerals including folate, iron, calcium, magnesium and zinc, among others (Table 1, 2). Pulses are also good sources of plant bio actives such as dietary fibre, saponins, prebiotics such as fructo-oligosaccharides, protease inhibitors, tannins, isoflavones and anthocyanins (Table 3) (Madhujith et al., 2004). Having a low glycemic index (GI) ranging from 25 - 45, pulses do not contribute to surges of plasma glucose after consumption (Singh et al., 2020). The low GI values of pulses are attributable to the high content of indigestible and slowly digestible carbohydrates.

Among Sri Lankans, the most popular pulse is red lentils which was earlier imported from India but currently from Australia and Canada. The high cooking yield, flavour, short cooking time, soft texture of the cooked seed, pleasant colour and aroma and most importantly, the relatively low price, have contributed to its popularity over other pulses. Having considered the beneficial effects of pulses, the Sri Lankan government has initiated a number of programmes to promote pulse cultivation and consumption. During the period of 1970-1977, there have been many attempts by the Department of Agriculture to promote Pigeon pea as a substitute for red lentils which was imported into the country.



Pigeon pea is a hardy plant that can withstand dry conditions and pest attacks. However, processing of pigeon pea was quite difficult. After 1977, the government commenced importing red lentils. As a result, the popularity of pigeon pea declined drastically and this programme was nearly abandoned.

Research and development in relation to cultivation, breeding and promotion come under the purview of the Field Crop Research and Development Institute, Maha Iluppallama of the Department of Agriculture, while research relating to the nutritional aspects are carried out at the Pulses and Oil Crop Research and Development Centre, Angunakolapelessa.





NUTRITIONAL SIGNIFICANCE OF PULSES

Table 1. Proximate composition of selected local varieties of pulses on percent dry weight basis

Legume	Variety	Moisture	Ash	Protein	Fat	Crude Fibre	Carbohydrate
Green gram	MI 5	12.0	3.96	25.6	1.54	5.55	63.0
	MI 6	11.5	3.95	26.6	1.25	5.01	51.7
Cowpea	ANKCP1	11.0	4.10	24.9	2.03	5.75	57.2
	MICP1	6.81	4.30	25.2	1.86	3.04	51.8
	Bombay	11.0	3.43	25.0	1.81	4.36	52.2
	Waruni	11.0	3.78	25.0	1.51	6.84	58.8
	Dhawala	9.50	3.62	22.8	1.72	5.06	54.4
Horse gram	ANK Black	9.01	3.57	22.0	0.85	6.87	57.7
	ANK brown	9.00	3.56	24.2	0.78	6.7	55.76

Gunatilake et al. (2016) and Grain Legume and Oil Crop Research and Development Centre, Angunakalapelessa, Sri Lanka (2016).

Table 2. Mineral composition of selected local varieties of pulses (mg/100 g on dry weight basis)

Legume	Variety	Iron	Calcium	Zinc	Potassium	Phosphorous
Green gram	MI 5	2.69	29.0	1.67	1000	394
	MI 6	2.83	27.4	1.71	1200	438
Cowpea	ANKCP1	2.83	15.0	2.30	1200	396
	MICP1	2.26	29.4	2.04	1000	441
	Bombay	3.54	27.8	2.82	1300	360
	Waruni	3.49	29.9	2.63	1200	424
	Dhawala	2.42	23.3	2.20	1100	372

Gunatilake et al. (2016)


Table 3. Bioactive constituents in pulses and beneficial health effects

Bioactives reported in pulses		Beneficial Effects of Pulses
Group of Compound Polyphenols	Bioactive	Hypolipidemic effects
	Flavanols	Antimutagenic activity
	Flavan-3-ols	Anti-carcinogenic activity against colon and breast cancers
	Anthocyanins	Fat excretion
	Condensed tannins	High satiety
	Phenolic acids	Weight management and
	Isoflavones	Reduction of obesity
Sterols	β -Sitosterol	Hypocholesterolemic activity
	Campesterol	Reduction of cardiovascular disease incidences
	Stigmasterol	
	Avenasterol	
	Glycosylated sterols	
Insoluble Dietary Fibre	Cellulose	
	Some hemicellulose	
	Lignin	
	Arabonoxylan	
Soluble Dietary Fibre	Pectins	
	Gums and mucilages	
	β -Gulcan	
	Some hemicellulose	
	Resistant starch	
	Oligosaccharides	
Prebiotics	Oligosaccharides	
	Inulin	
Others	Trypsin inhibitors	
	Chymotrypsin inhibitors	
	Alkaloids	
	Carboxypeptidase inhibitors	
	Saponins	

Madhujith et al. (2004) and Singh et al. (2017)



WHY PULSES OTHER THAN RED LENTILS ARE LESS POPULAR AMONG SRI LANKANS ?



Low yield of pulses per unit area

The yield of cowpea and green gram reported in 2018 were 729 kg/ha in the Ampara district and 655 kg/ha in the Hambantota district, respectively (Census and Statistics, 2019). These are very low values compared to many other crops such as maize, big onions, paddy and vegetables. The average yield of maize, rice and brinjals in the dry zone was 3496 kg/ha, 4400 kg/ha and 22000 kg/ha, respectively. As a result of the low yield obtainable per unit area of land, many farmers opt for other high yielding crops.

High market price and fluctuation of prices of pulses such as green gram, black gram and cowpea

The cost of one kilo of these pulses goes up to LKR 600-750. Red lentils which are priced between LKR 130-185 invariably attract customers. Consumers can purchase 5-6 kg of red lentils at the cost of 1 kg of other pulses such as green gram.

Most of the locally available pulses show a low cooking yield compared to red lentils which gives a high cooking yield

The quality of cooked locally available pulses is not in par with that of red lentils. Upon cooking, lentils become more integrated into the liquid portion in the curry and tends to make a thick paste while pulses such as green gram, black gram, cowpea, beans and chick-pea tend to stay separate from the curry. Consumption of bread with curried lentils is very common among Sri Lankans, and for this purpose the vast majority prefers a thick curry. Moreover, the flavour of red/yellow lentils is more attractive. As a result, the overall quality of cooked lentils is considered better.



Pre-treatments required before cooking

Most of these pulses except for lentils need to be soaked in water overnight before cooking.

High cooking time involved

Lentils can be cooked in 10 minutes while other pulses require 20-25 minutes for cooking.

Abdominal discomfort that a significant proportion of consumers develop following consumption of green gram, black gram and cowpea is quite common.

Problems encountered in the storage of grains. Green gram is highly vulnerable to pest attacks. Pulse beetle (*Callosobruchus chinensis*) infests green gram in the field, and upon storage, they destroy a significant proportion. Therefore, many traders do not like to store green gram.

Poor storage facilities available.

Most of the storage places are of poor quality, leading to a conducive environment for storage pests.

Hardening of seeds

Green gram seeds become hardened during storage reducing the quality. Storage over three months leads to the development of hard seeds.

Poor availability of seeds and planting materials

Commercial availability of good quality seeds is limited. Therefore, farmers find it difficult to obtain seeds in required quantities at the correct time for planting.

The current need of both green gram and black gram is estimated to be nearly 25,000 MT per year, while that of cowpea is estimated to be nearly 9,000 MT (AgStat, 2015-2018 and Central bank Statistics, 2015-2018). A multi-pronged approach is suggested to improve the utilisation of locally cultivated pulses such as cowpea, green gram, black gram and horse gram.





ACTIONS PROPOSED TO INCREASE THE UTILIZATION OF PULSES

-  Enhance utilisation of pulses especially green gram, black gram, cowpea and horse gram by creating awareness among consumers. It is important to provide publicity regarding the benefits associated with the consumption of pulses.
-  Exploration of the possibility of developing composite flour mixtures substituting wheat flour with pulse flour in products such as cookies, flour mixes such as dosai, string hopper and hopper flour mixes. There is quite a heavy demand for these flour mixes and pulse flour can be added to these. Incorporation of pulses into breakfast cereals is also a possibility.
-  Development of canned pulses in brine or sauces. Canned beans, baked beans and similar convenient products are very popular in the international market. However, these are novel to Sri Lanka. Therefore, reasonably priced canned pulses can be made available and promoted among consumers as convenient products.
-  Popularisation of pulse sprouts. Pulse sprouts such as green gram sprouts are nutritionally rich products. However, they are difficult to be found in the market. Sprouted pulses packed in appropriate consumer size packages is recommended.
-  Development of novel products such as pulse flour added pasta, texturised vegetable protein products, fried or roasted snacks/trail mixes, bean curd, and meat analogues such as vegetarian sausages.
-  Popularisation of splits especially green gram and cowpea splits. Green gram splits are easy to cook and more palatable than whole seed. Many prefer to consume green gram splits as splits can be easily cooked; this serves as a good substitute for red lentils. The removal of the hard seed coat improves consumer acceptance, utilisation and digestibility. However, during splitting the hard seed coat is removed and as a result dietary fibre, lipids, phenolic compounds, saponins and other beneficial compounds are removed.
-  Development of good quality seeds with high viability. The Department of Agriculture can introduce intercropping pulses with other potential crops. Research should be focused on high yielding cultivars, pest resistance and bio fortification of pulses with vitamins and minerals.
-  Popularisation of underutilised pulses. There are a few pulses which have been grown in the country for many decades. However, these remain as underutilised crops with minimum availability. Green gram varieties such as Gaja mun, Heen mun, Kaha mun, Kol mun, Katta mun, Loku mun, Pinna mun, Tel mun and Weda mun, and horse gram varieties such as Ala, Kalu, Rathu, Weda, and Sudu are some examples of underutilised pulses in Sri Lanka. These varieties possess better nutritional value and should be focused on in pulse breeding programmes.



©Anoma Chandrasekara

- ✿ Exploration of the possibility of using dried seeds of legumes such as winged beans (*Psophocarpus teragonolobus*): Awara, Beti, Nil, Bonchi, Daluk, Dara, Kola, Halmessan, Heen, Iththe, Komaranga, Kiri, Koladiga, Kota, Maha, Pathok, Pothu and Rathu, and long beans: Bin, Bu, Gasmе, Hawari me, Heen me, Kola me, Katu me, Leena me, Mahalee, Murunga, Nil, Pathuru me, Patta me, Polon me, Rathu me, Rathupatta me, Sudu me, Sudukonda me and Wanduru me.
- ✿ Improvement of storage facilities through the adoption of modified atmospheric storage. One of the variants of modified atmospheric storage is hermetic storage for pulses which the Department of Agriculture has already introduced, where grains are stored in sealed plastic containers thereby modifying the storage environment. This increases the carbon dioxide content and reduces the oxygen level, making it non-conductive for storage pests. Hermetic storage should be popularised among farmers, and purchase and installation of storage bins should be supported.
- ✿ Improvement of the collection process from farmers and middlemen engagement. Setting up collecting centers along with paddy collection can reduce the impact of middlemen. This reduces the price gap between the farm gate price and the final selling price. The difference between farm gate price and retail price of pulses (based on 2016 data) is as follows: Cowpea - 40%, black gram - 92% and green gram 17%. The price difference of 40% and 90% is very high and leads to a high price for the consumer. Currently (November 2020), the market price of pulses stands at LKR 600-700 per kg. Introduction of a control price would reduce high price fluctuation.



-  The establishment of green gram villages has been identified under the national food production programme in 2016 - 2018. This should be continued with proper evaluation and extended to other pulses such as black gram, cowpea and horse gram.
-  Promotion of green gram and other pulses in the third season, especially in the dry zone.
-  Assisting farmers and producers with modern processing equipment for cleaning and splitting.
-  Making pulses available at affordable prices for the consumer will increase consumption.
-  Recipe development, including pulses for cooking demonstrations, prioritising local pulses in school programmes, popularising pulse products through Hela Bojun and other fast-food outlets and celebration of the Pulse Day every year.



©Anoma Chandrasekara

SUMMARY

Pulses are rich sources of carbohydrate, proteins, minerals, vitamins and a plethora of beneficial phytochemicals. Therefore, they play a significant role in nourishing the nation. Nearly 90% of pulse consumption is met through imported lentils whereas the use of cowpea, green gram, horse gram and chickpea is very marginal. Moreover, there are many underutilized pulse varieties present in the country which are not widely available in markets. Promotion of these pulses is a timely need in order to increase consumption among Sri Lankans.



REFERENCES

- ✿ Census and Statistics (2019).
- ✿ Central Bank reports of Sri Lanka (2015-2018).
- ✿ AgStat (2015-2018)
- ✿ FAO (1994). Definition and classification of commodities.
<http://www.fao.org/es/faodef/fdef04e.htm>. Retrieved on 24-11-2020.
- ✿ Gunatilake, K.G.T., Herath, T. and Wansapala, J. (2016). *Comparison of physicochemical properties of selected locally available legumes varieties (mung bean, cowpea and soybean)*. *Potravinarstvo Scientific Journal for Food Industry*. 10(1) 424-430.
- ✿ Madhujith, T., Amarowicz, R. and Shahidi, F. (2004). *Phenolic Antioxidants in Beans and Their Effects on Inhibition of Radical-Induced DNA Damage*. *Journal of American Oil Chemists' Society*. 81(7), 691-696.
- ✿ Singh, M. Manickavasagan, A. Shanmugam, S. Viswanathan, M. (2020). *Glycemic index of pulses and pulse-based products: a review*. *Critical Reviews in Food Science and Nutrition*. 1-22.10.1080/10408398.2020.1762162

ACKNOWLEDGEMENTS

This technical brief was funded by the Food and Agriculture Organization of the United Nations (FAO) and produced by the Nutrition Society of Sri Lanka, Wayamba University of Sri Lanka and Dietetic Association of Sri Lanka.

AUTHORS AND CONTRIBUTORS

Terrence Madhujith - Nutrition Society of Sri Lanka/University of Peradeniya

Roshan Delabandara - Nutrition Society of Sri Lanka

Renuka Silva - Wayamba University of Sri Lanka

Lakmini Thilekeratne - Dietitians' Association of Sri Lanka

Anoma Chandrasekara - Nutrition Society of Sri Lanka/Wayamba University of Sri Lanka





Food and Agriculture
Organization of the
United Nations



NUTRITION SOCIETY
OF SRI LANKA

