



Food and Agriculture
Organization of the
United Nations

MAINSTREAMING NUTRITION IN THE AGRICULTURE SECTOR IN SRI LANKA

TECHNICAL BRIEF

WHOLE GRAIN CEREALS



INTRODUCTION

Cereals are the edible seeds of the grasses belonging to the family Gramineae. Several cereals are commonly grown in different regions of the world including wheat, rice, maize, barley, rye, oats, millet, sorghum and triticale. Amongst all, wheat and rice are the most important cereal crops accounting for over 50% of the global cereal production. Although cereal grains share the same structure, the percentages of nutrients and bioactive compounds vary depending on the cereal species, cultivar, intensity of the milling process and its growing conditions.

Cereals provide more food energy worldwide than any other type of crops. Besides providing a high amount of carbohydrates, cereals contain protein, a number of vitamins, minerals, dietary fibre and phytochemicals such as phenolic acids, and flavonoids.

Most of the non-carbohydrate nutrients, water insoluble dietary fibre and phytochemicals are concentrated in the bran including the aleurone layer and the germ. During the refining process of cereals, bran and germ are partially or completely removed, and so are the aforesaid nutrients and other dietary components.

The choice of whole grain cereals in the daily diet is linked with reduced level of non-communicable diseases such as type 2 diabetes, cardiovascular diseases and colorectal cancer.

Cereals grown in Sri Lanka include new improved rice, traditional rice, maize, sorghum, and millets such as kodo millet (*Paspalum scrobiculatum*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*) and proso millet (*Panicum miliaceum*).

More than 3,000 traditional rice varieties have been recorded in Sri Lanka but most of them are now extinct. Nearly 200 varieties are available today, cultivated in small quantities in different parts of the country. Although maize is cultivated in significant quantities in Siyabalanduwa, Moneragala and Wellawaya areas, it is mainly used in the formulation of animal feed. Sorghum and millets are cultivated on a small scale in the country and therefore, their availability is very minimal. What is grown is mostly utilised as bird feed.

The commonly available cereals in the market for day-to-day consumption include a few varieties of new improved rice. The annual per capita consumption of rice fluctuates around 100 kg depending on the price of rice, wheat flour and bread. Anuradhapura, Kurunegala Ampara and Polonnaruwa are the major rice producing districts. The estimated paddy production in the Yala season in 2019 was 1,519,475 metric tons (Census and Statistics, 2019).

The type of rice consumed is greatly influenced by geographical location and cultural influences. Red rice is popular among the consumers in the Northern and Southern provinces while white rice is popular in other areas. It was found that 67% of respondents from Moneragala district consume white Kekulu rice, while 48% in Kandy consume white parboiled rice, while white samba rice is consumed in significant quantities in both districts (World Food Programme, 2017). Parboiled rice is more nutritious than Kekulu (raw) as a portion of the nutrients is absorbed into the rice grain in the process.

Moreover, parboiling gelatinises some of the starch leading to the generation of resistant starch. As a result, the glycaemic index of parboiled rice goes down slightly.





Table 1. Nutritional composition of cereals in Sri Lanka (per 100g of edible portion at 12% moisture)

Cereal	Energy (kcal)	CHO (g)	Protein (g)	Fat (g)	CF (g)	Calcium (mg)	Iron (mg)	Niacin (mg)
Less polished rice	362	76.0	7.9	2.7	1.0	33.0	1.8	4.3
Wheat	348	71.0	11.6	2.0	2.0	30.0	3.5	5.1
Maize	358	73.0	9.2	4.6	2.8	26.0	2.7	3.6
Sorghum	329	70.7	10.4	3.1	2.0	25.0	5.4	4.3
Finger millet	336	72.6	7.7	1.5	3.6	350	3.9	1.1
Foxtail millet	351	63.2	11.2	4.0	6.7	31.0	2.8	3.2
Proso millet	364	63.8	12.5	3.5	5.2	8.0	2.9	4.5
Little millet	329	60.9	9.7	5.2	7.6	17.0	9.3	3.2
Kodo millet	353	66.6	9.8	3.6	5.2	35.0	1.7	2.0

CHO - Carbohydrates; CF- Crude Fibre
Source: FAO (1995).



MAIN ISSUES REGARDING CEREAL CONSUMPTION

- Over consumption of refined cereals. On average, more than 14 servings are consumed by a Sri Lankan as against the recommended number of portions of 6-11 (Jayawardena et al., 2012). Consumption of a high volume of rice rich in carbohydrate has been a tradition in Sri Lanka, as people in the past required a high amount of energy to work in paddy fields and work sites. Unfortunately, the same food consumption pattern continues despite the sedentary life many live nowadays.
- Consumption of a high amount of rice along with a small quantity of vegetables, pulses, meat or fish is very common. Fried rice has become a very popular food in the country. Fried rice contains a small amount of vegetables and or meat and a high quantity of boiled rice. Many attempt to meet their calorie demand by consuming a meal rich in rice.
- Low consumption of whole grain cereals. Most of the rice available in the market is polished or refined. During the polishing process, most of the bran and the germ which are rich in micronutrients and dietary fibre are removed. The rest of the kernel contains mainly starch, with meagre amounts of protein. The storage life of polished rice is higher. Thus, millers and traders prefer to produce polished rice.
- Less availability of whole wheat bread and other baked goods produced using millets and other traditional cereals. Whole wheat and multi-grain bread are quite common in the international market but are rare in the local market.
- Limited variety of cereals available in the market. The main cereals consumed are rice and wheat, while the other cereals such as millets, sorghum and maize are rarely consumed.
- Poor quality of rice. Nearly 40% of commercial mills use modern rice processing including cleaning, de-stoning, de-husking, polishing and grading, but the others use old technology and equipment, leading to a poor-quality end product. As a result, they exhibit a high percentage of broken rice and low milling yield.
- Control of the market price of rice by large scale and leading mills. The large scale operators with access to mega storage facilities, collect paddy during the harvesting season and store them for long. These paddy stocks are milled and released into the market during lean off-seasons with the aim of reaping high profits. This way, the large scale traders keep the prices in their hands. As a result, the gap between farm gate price and retail price is widened.
- Low availability of convenient ready-to-eat cereal products in the market at an affordable price. Many consumers are not used to consuming convenient, ready-to-eat cereal products such as breakfast cereals. High market prices also contribute to less demand for these products. Ready-to-eat breakfast cereals are more nutritious than traditional wheat or rice-based products such as string hoppers, hoppers, pittu, rotti and parata since they include a mixture of cereals and are mostly fortified with vitamins and proteins.



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- ✿ Less availability of whole cereal flour in the market. Whole wheat flour (Atta flour) is available only in small quantities as there is not much demand for these products. The available products are generally costlier than refined wheat flour.



- ✿ Lack of high yielding millets and sorghum varieties in the country. Breeding programmes mostly concentrate on developing rice and there is a limited focus on the development of underutilised minor cereals.
- ✿ Lack of focus on nutritive value in the selection and breeding programmes of cereals. The breeding programmes mainly focus on the yield and pest resistance while the focus on the nutritional quality has been lacking.
- ✿ The use of old technology and equipment in cereal processing. Most of the large and medium scale mills use modern technology and equipment while some of the small and custom mills do not have access to modern equipment. Nearly 40% of the share lies with these small and custom mills. Thus the quality of processed rice is affected by the use of old methods and equipment for processing.
- ✿ Heavy usage of fumigants during storage of cereal grains. As many large scale traders/mills stockpile paddy during the season, it has to be stored for quite a lengthy period of time. This demands the use of fumigants or storage pest repellents. Therefore traders tend to fumigate paddy/rice frequently to protect the produce from storage pests. Although most of the phosphine used as fumigant is released, impurities may contaminate rice.
- ✿ Lack of widespread technologies to process other cereals such as millet and sorghum in Sri Lanka.
- ✿ Lack of novel technology for parboiling. Although large and medium scale millers have adopted short time parboiling methods that yield high quality rice, many small and custom mills do not possess this technology. As a result, they still use traditional parboiling methods, leading to poor quality rice with an objectionable smell which many consumers do not like.

SUGGESTIONS TO IMPROVE

- ✿ The importance of the consumption of minor cereals such as millets and traditional rice varieties should be promoted, creating consumer awareness.
- ✿ The products prepared using whole grain rice, millets, sorghum, maize and traditional rice should be popularised among consumers. This can be achieved through awareness programmes and approaching fast food chains, school and office cafeterias. The possibility of incorporating the flour of millets, sorghum, maize and traditional rice can be encouraged to large and medium scale food processors and bakers.
- ✿ Popularisation of multi-grain and whole grain products and other specialty cereal product types among Sri Lankans. Bread, buns, roti, string hoppers, pittu, dosai and similar products can be developed incorporating whole grain cereals. The addition of more than one type of cereal will add more nutritional value to the product as the nutrient and bio actives composition varies with the variety.
- ✿ Promotion of breakfast cereal products and making them available at reasonable prices in the local market. Most of the breakfast cereal products are imported and are taxed heavily. As a result, the market price of these products is high, and the general public find it difficult to afford them. These breakfast cereal products can be manufactured in the country using local raw materials such as maize, millets and sorghum combined with pulses.



- ✿ New recipes and product developments incorporating whole grain cereals. Cooking demonstrations, competitions, newspaper articles and documentaries may be helpful.
- ✿ Increasing the availability of whole grain and underutilised cereal flour in the market at an affordable price, so that they can be incorporated into home-made products such as roti, string hoppers, hoppers, dosai and pittu.
- ✿ Setting guidelines and regulations on the extraction rate for rice. Rice mill operators can be directed to reduce the level of polishing so that more bran and germ is retained in the grain after processing. There are nearly 7,120 rice mills in operation in the country of which 4.2% are leading mills processing more than 50 MT/day, while 25.3% are medium mills and 29.5% are large mills (Dissanayake, 2017). Altogether, approximately 60% of local rice mills belong either to the medium or large scale category. However, implementation of the extraction rate is difficult with small and custom mills. There are nearly 6,500 custom and small scale mills operating the country.
- ✿ Bakers and confectioners should be encouraged to partially substitute wheat flour with local whole cereal grain flour in products such as bread, cake, buns, cookies, crackers, sweets etc.
- ✿ Upgrading mills which currently use old technology and equipment for rice processing. Some of the small and custom mills still use old equipment leading to poor quality cereals. It is difficult to control the extraction rates with old equipment.
- ✿ Introducing novel technology for parboiling to small and custom mills. The conventional parboiling methods used by small and custom mills lead to poor quality rice with objectionable odours. Therefore, it is important to introduce novel parboiling technology to them.
- ✿ Exploring the possibility of the utilisation of rice bran in products. Rice bran is a rich source of gamma oryzanol which has antioxidant activities. It is necessary to encourage rice bran-based products to be made available in the market. Rice bran is easily oxidised due to the presence of lipids and lipases enzymes. Following the inactivation of enzymes, rice bran can be utilised for product development.
- ✿ Farmers should be encouraged to produce underutilised cereals such as millets to meet emerging demands.
- ✿ It is important to initiate breeding programmes focusing on high yielding millet and sorghum varieties.
- ✿ Good quality seeds should be made available for planting.
- ✿ Cereal biofortification and fortification need to be encouraged to ensure intake of essential micronutrients through staple food.





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SUMMARY

Cereals play a crucial role in the human diet. While rice is the staple food for many Sri Lankans, imported wheat-based products are also very popular in the country. Besides, there is a potential for many underutilised cereals such as millets to be grown in the country, but these are not properly utilised at the moment. Rice and wheat available in the market are mainly refined, while whole grain or unrefined cereals have a limited availability. As a result, the vast majority of food products prepared using rice and wheat flour also contain refined cereals. In this context, most of the micronutrients and dietary fibre are lost. Therefore, it is important to promote currently underutilised millets, sorghum and traditional rice varieties and make them available for consumers. It is also important to utilise whole grain flour for the production of baked goods, while making arrangements to carry out social marketing for whole cereal grain consumption.



REFERENCES

- ✿ Bartłomiej, S., Justyna, R-K. and Ewa, N. (2011). Bioactive compounds in cereal grains – occurrence, structure, technological significance and nutritional benefits – a review. *Food Science and Technology International* 18(6), 559-568.
- ✿ Department of Census and Statistics (2012). Household income and expenditure survey.
- ✿ Department of Census and Statistics (2020). Paddy statistics.
- ✿ Dissanayake, M. (2017). A presentation made by the author, Postharvest Institute of Technology, Ministry of Agriculture, Sri Lanka.
- ✿ FAO (1995). Food and Agricultural Organization
- ✿ Helvetas Sri Lanka (2001). Sustainable Farming System through Traditional Plant Genetic Resources and Indigenous Knowledge Based Practices, Helvetas Sri Lanka. pp. 1-137.
- ✿ Jayawardena, R., Byrne, N.M., Soares, M.J., Katulanda, P. and Hills, A.P. (2012). Food consumption of Sri Lankan adults: an appraisal of serving characteristics. *Public Health Nutrition*. 1-6. doi:10.1017/S1368980012003011
- ✿ Senanayaka, S.M.P. and Premaratne, S.P. (2016). An analysis of the paddy/rice value chain in Sri Lanka, University of Colombo, Sri Lanka, ASARC Working Paper.
- ✿ World Food Programme (2017). Rice fortification: A study to assess its acceptability, production and utilization in Sri Lanka. P. 30.

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