SORGHUM AND MILLETS

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Summary

The world sorghum economy consist of two distinct sectors a traditional, subsistence, smallholder farming sector where most production is consumed directly as food (mainly in Africa and Asia), and a modern, mechanized, high-input, large-scale sector where output is used largely as animal feed (mainly in the developed countries and in Latin America).The future of the sorghum economy is linked with its contribution to food security in Africa, income growth and poverty alleviation in Asia, and efficient use of water in drought-prone regions in much of the developed world. Millet will remain largely associated with the food security of drought-prone human populations. Productivity has lagged, particularly in Africa, because of the severity of this environment and the pressure of human population growth on traditional land-extensive fallow system. In many countries of the world researchers look for the best growing and using possibilities for sorghum and millet of high energy content. Completely new food products can be produced by introducing new types, optimizing growing technologies (watering, weed control, storage conditions, developing instruments etc.), and applying new hydrothermic technologies. The flaked, puffed and extruded sorghum and millet products, with the addition of some nutrients, can considerably enlarge the food variety of the developed countries too.

1. Introduction

Sorghum is the world's fifth most important cereal, in terms of both production and area planted. Millet, a general category for several species of small grained cereal crops, is the world's seventh most important cereal grain. Roughly 90% of the world's sorghum area and 95% of the world's millet area lie in the developing countries, mainly in Africa and Asia. These crops are primarily grown in poor areas subject to law rainfall and drought where other grains are unsuitable for the production unless irrigation is available.

Sorghum is widely grown both for food and as a feed grain, while millet is produced almost entirely for food. Sorghum and millets constitute a major source of calories and protein for millions of people in Africa and Asia.

2. Sorghum (Sorghum bicolor /L./ Moench)

2.1 History, Taxonomy and Distribution

2.1.1. History

Vavilov considered the old Abyssinian (Ethiopian) areas the centre of origin of sorghum, but others (Harlan, Snowden) thought that sorghum arose in several separate centres and from different species: races durra and bicolor from *S. aethiopicum*, guinea from *S. arundinaceum*, and kafir from *S. verticilliflorum*. According to de Wet the *S. verticilliflorum* was the first to be domesticated some 3000 to 5000 years ago (David A. V. Dendy 1995).

2.1.2. Taxonomy

Pliny (ca. 60 to 70 A. D.) was the first to give a written description of sorghum and after that there was hardly a mention of it until the sixteenth century. Moench in 1794 established the genus *Sorghum* and brought the sorghums under the name *S. bicolor*. Harlan and de Wet (1971) developed a simplified classification that is in common use. There are a total of 15 races The basic races are bicolor, guinea, caudatum, kafir, durra, and there are ten hybrid races under *S. bicolor* subsp. *bicolor*. Sorghum is a cereal of remarkable genetic variability—more than 30 000 selections are present in the world and it is very difficult to classify them. Sorghum belongs to the order of *Poales* and to the family of *Gramineae.* The species *Sorghum bicolor* covers a wide range of varieties, from white and yellow to brown, red and almost black (Figure 1).

2.1.3. Distribution

Sorghum is a tropical grass grown primarily in semi-arid parts of the world. In Africa, a major growing area runs across West Africa south of the Sahara, through Sudan, Ethiopia and Somalia. It is grown in upper Egypt and Uganda, Kenya, Tanzania, Burundi, and Zambia. It is important crop in India, Pakistan, Thailand in central and northern China, Australia, in the drier areas of Argentina and Brazil, Venezuela, USA, France and Italy. The crop has spread over the drier areas of the world; it does better when it is dry and cool, whereas pearl millet is better adapted to dry hot conditions. Sorghum is a staple food for about 300 millions people worldwide.

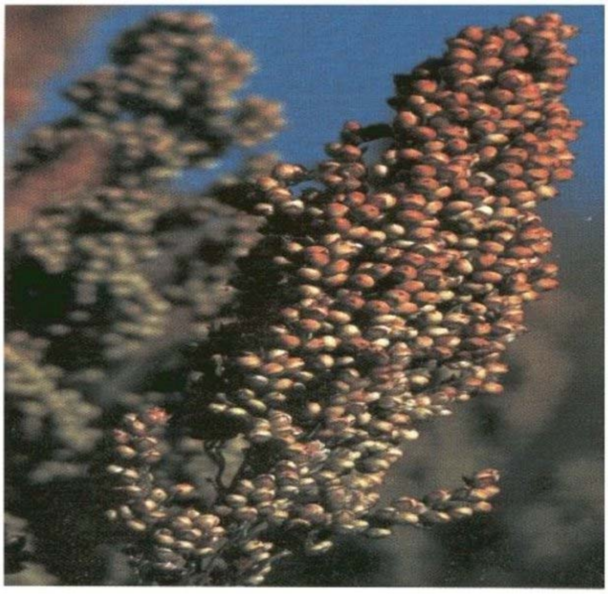

Figure 1: Sorghum

2.2. Chemical Composition (Carbohydrates, Proteins, Lipids, Vitamins and Minerals)

Sorghum is similar in chemical composition to corn (*Zea mays*). A comparison of nutrients in various cereals is presented in Table 1.

Cereal	**Protein[b] (g)**	**Fat (g)**	**CHO[c] (g)**	**Crude Fiber (g)**	**Ash (g)**	**Energy (kcal)**	**Calcium (mg)**	**Iron (mg)**	**Thiamin (mg)**	**Niacin (mg)**	**Riboflavin (mg)**
Wheat	11.6	2.0	71	2.0	1.6	348	30	3.5	0.405	5.05	0.101
Brown rice	7.9	2.7	76	1.0	1.3	362	33	1.8	0.413	4.31	0.043
Maize	9.2	4.6	73	2.8	1.2	358	26	2.7	0.378	3.57	0.197
Sorghum	10.9	3.2	73	2.3	1.6	329	27	4.3	0.300	2.83	0.138
Pearl millet	11.0	5.0	69	2.2	1.9	363	25	3.0	0.3	2.0	0.15
Foxtail millet	9.9	2.5	72	10.0	3.5	351	20	4.9	0.593	0.99	0.099
Finger millet	6.0	1.5	75	3.6	2.6	336	350	5.0	0.3	1.4	0.10
Kodo millet	11.5	1.3	74	10.4	2.6	353	35	1.7	0.15	…	…
Japanese barnyard millet	10.8	4.5	49	14.7	4.0	…	22	18.6	…	…	…
Proso millet	10.6	4.0	70	12.0	3.2	364	8	2.9	0.405	4.54	0.279

Table 1: Comparison of nutrients in 100-g edible portions of various cereals at 12% moisture

[a] Data from Hulse et al (1980), NRC/NAS (1982), USDA/HNIS (1989), Serna-Saldivar and Rooney (1991); [b] NX6.25; [c] Carbohydrates)

2.2.1. Carbohydrates

The majority of the carbohydrate in sorghum and millets are starch, while soluble sugar, pentosans, cellulose, and hemicellulose are low. Regular endosperm sorghum types contain 23 to 30% amylose, but waxy varieties contain less than 5% amylose.

Sorghum is a good source of fibre, mainly the insoluble (86.2%) fibre. The insoluble dietary fibre of sorghum and millet may decrease transit time and prevent gastrointestinal problems.

2.2.2. Proteins

Protein content and composition varies due to genotype, and water availability, temperature, soil fertility and environmental conditions during grain development. The protein content of sorghum is usually 11-13% but sometimes higher values are reported (David A. V. Dendy, 1995).

Prolamins (kafirins) constitute the major protein fractions in sorghum, followed by glutelins. Lack of gluten is characteristic of protein composition, and traditionally, the bread which cannot be baked from sorghum and millet is only cake bread.

In contrast to the unbroken protein matrix of wheat grain there are separate protein bodies which can be distinguished in the endosperm of the ripe seeds of the sorghum and millet. Grain protein is notoriously deficient in the essential amino acid lysine (except for several new varieties of high lysine sorghum) and pure in the sulphur-containing amino acids. In vitro studies and in vivo studies with livestock and laboratory animals, indicate that sorghum proteins are generally less digestible than those of other cereals. Sorghum was shown to be 74.5%, compared with 78.5% for corn.

2.2.3. Lipids

Crude fat content of sorghum averages about 3%, which is higher than that of wheat and rice. Fatty acid composition is similar to that of corn oil, with high concentrations of linoleic (49%), oleic (31%) and palmitic acids (14%). Like maize, the energy content of sorghum is high. Sorghum grain contains about 1.5 ppm of total carotenoids. Apart from maize and durum wheat, sorghum is the only cereal which contains a significant amount of β-carotene, the provitamin of vitamin A, which is important in human physiology.

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Biographical Sketch

Ms. Irén Léder was born in September1946 in Budapest, Hungary. Since 1995 she has been employed as a research scientist in the Central Food Research Institute (CFRI), in Budapest. She qualified as a food preservation engineer (University of Horticulture and Food, 1984) and worked from 1965 to 1985 in the National Institute of Food Hygiene and Nutrition, Budapest. From 1985 to 1995 she worked for the Research and Development of Flour Milling Co. Ltd., Budapest

She has worked on:

- Product development in the flour milling industry by traditional and new hydrothermal technologies which are able to conserve the nutritional value of cereals.
- Product development of flaked, puffed and extruded cereal and pseudocereal products, as well as the improvement of dehulled products (buckwheat, millet, sorghum), elaboration of cereal ready mixed flours and vitamins and mineral-enriched flours.
- Elaboration of health protecting and high nutritional value food products using different cereals and pseudocereals
- Elaboration of technologies and recipes of bio-food products using cereal basic materials grown without chemicals.
- Keeping contact with grain industrial, milling, bakery and confectionery enterprises by looking for utilization possibilities of research results and help in the realization of new product development results,

Her publications include:

Biacs P. Á., Léder I. and Lajos J. (1998). Production and use of special cereals and pseudocereals (buckwheat, amaranth) in Hungary. 16th ICC Conference, 9-12 May, Vienna. Book of Abstracts.

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