Durum wheat products

Elias E.M.

in

Di Fonzo N. (ed.), Kaan F. (ed.), Nachit M. (ed.).
Durum wheat quality in the Mediterranean region

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 22

1995
pages 23-31

Durum wheat products

E.M. ELIAS
CROP AND WEED SCIENCES DEPARTMENT
NORTH DAKOTA STATE UNIVERSITY
FARGO
USA

SUMMARY - Durum wheat is one of the most important cereal crop in the world. It is cultivated in semiarid regions of the world such as North Africa, Mediterranean Europe, the North American Great Plains and the Middle East. Its kernel size, hardiness and golden amber colour make it most suitable for manufacturing a unique and diverse range of food products. Pasta and couscous are the most common paste products made from durum wheat. Pasta is considered one of the major food staples in most parts of the world. Couscous has long been a staple food in North Africa. Bulgur and frekeh are non-paste durum wheat products that are a staple food in the Middle East and North Africa. Durum flour is used to some extent in bread production especially in Europe and the Middle East. Durum wheat is also used to produce breakfast cereals and desserts such as *mamuneih*, *mushabak*, *hariseh*, *halva* and *kugel*. Paste and non-paste durum wheat products are briefly discussed in this paper as a review for the reader.

Key words: *Triticum turgidum* var. *durum*, pasta, bulgur, frekeh, couscous, bread.

RESUME - *"Produits à base de blé dur". Le blé dur, qui est parmi les céréales les plus importantes, se cultive dans des régions semi-arides du monde telles que l'Afrique du Nord, l'Europe Méridionale, les plaines de l'Amérique du Nord et le Moyen-Orient. Grâce à la taille de son grain, sa vigueur et sa couleur d'ambre, le blé dur se prête à une gamme de produits alimentaires uniques et divers dont les pâtes et le couscous sont les plus connus. Les pâtes sont en effet l'un des produits alimentaires de base pour une grande partie du monde, de même pour le couscous en Afrique du Nord. Le bulgur et le frekeh, produits du blé dur mais pas des pâtes, sont des produits essentiels au Moyen-Orient et en Afrique du Nord. On utilise aussi le blé dur dans la production de farine, surtout en Europe et au Moyen-Orient. Le blé dur s'adapte aussi aux céréales en flocons (celles du petit-déjeuner) et aux desserts tels que mamuneih, mushabak, hariseh, halva et kugel. Dans cette étude on parle brièvement des produits à base de blé dur pâtes et non-pâtes afin de récapituler pour le lecteur.*

Mots-clés : *Triticum turgidum var. durum, pasta, bulgur, frekeh, couscous, pain.*

Introduction

This paper is not intended to be a report on a specific project. It is a general review of durum wheat and its products, including the history, production, manufacturing, and economic importance of durum wheat, pasta, couscous, bulgur, frekeh, bread, and other products.

Durum wheat

Among all cultivated wheats, *Triticum aestivum* and *Triticum durum* are the most important cereal crops in the world. Durum wheat is a minor crop, grown on only 8 to 10% of all the wheat cultivated area. The remaining area is cultivated with hexaploid bread wheat (Dalrymple, 1978; Byerlee, 1981; Hanson *et al.*, 1982; International Wheat Council, 1982; Srivastava, 1984).

Durum wheat is better adapted to semiarid climates than is bread wheat. The world's durum wheat acreage and production is concentrated in the Middle East, North Africa, the former USSR, the North American Great Plains, India, and Mediterranean Europe (Table 1) (Cantrell, 1987; International Wheat Council, 1991). Durum is a spring wheat, although winter durum is grown. In spite of its low acreage, durum wheat is an economically important crop because of its unique characteristics and end products.

It is generally considered the hardest kernel of all wheats. Durum kernels are usually large, golden amber, and translucent.

Table 1. World production of durum wheat estimated in 1991 (International Wheat Council, 1991)

Country	Million tons	% of total
Italy	5.1	14.9
Turkey	5.0	14.6
Canada	4.6	13.4
United States	2.8	8.2
France	2.6	7.6
Greece	2.3	6.7
Morocco	2.2	6.4
Tunisia	1.4	4.1
Algeria	1.2	3.5
Argentina	0.1	0.3
Others	7.0	20.3

These characteristics, along with its protein content and gluten strength, make it suitable for manufacturing diverse food products. Pasta is the most common durum end product consumed in Europe, North America, and the former USSR. Products other than pasta are also made from durum wheat (Quaglia, 1988). Couscous, made from durum semolina, is consumed mainly in North Africa. Flat bread made from durum wheat and bulgur are part of the main diet in Jordan, Lebanon, Syria, and Turkey.

The quality of durum wheat is highly correlated with the quality of its end products. Durum wheat, with its high kernel weight, test weight, protein content, and gluten strength, is known to be associated with the firmness and resiliency of the cooked pasta products and the stability of cooking. To insure a good quality durum wheat, the objectives of breeding programs should be based on the demands of the producer, miller, processor, consumer, and the international export market.

The main objective of the durum wheat breeding and genetics project at the North Dakota Experiment Station is to release durum cultivars that maximize the economic return to the farmer and possess excellent quality for the domestic industry and the international export market. All experimental lines are tested for agronomic and quality traits before their release.

Durum wheat products

Semolina, durum granular, and durum flour milled from durum wheat are used to manufacture paste and non-paste food products. Paste products are manufactured by mixing water with semolina or durum flour to form unleavened dough, which is formed into different shapes and either cooked and eaten or dried for later consumption. Pasta and couscous are paste products. Products of durum wheat in a high moisture leavened or unleavened bread, cooked or steamed bulgur (cracked durum wheat) and frekeh (parched immature wheat kernel) are non-paste food products (Dick and Matsuo, 1988).

Pasta products

Pasta products are the most ancient source of food consumed from wheat. In the 15th century, the Germans taught the Italians how to make pasta, which became a flourishing home industry. In 1800, mechanical devices for making pasta appeared in Italy (Banasik, 1981). Italians categorize pasta into four main groups: long goods (spaghetti, vermicelli, and linguine); short goods (elbow macaroni, rigatoni, and ziti); egg noodles (pasta made with eggs); specialty items (lasagna, manicotti, jumbo

shells, and stuffed pasta) (Dick and Matsuo, 1988). Italian extruded food and Oriental noodles differ. Pasta noodles are made from durum or non-durum wheat with a minimum requirement of 5.5% egg solid; Oriental noodles are made from non-durum wheat flour.

In the Western Hemisphere and Europe, macaroni products are usually referred to as alimentary pastes. Macaroni (hollow tubes), spaghetti (solid rods), noodles (strips, either flat or oval), and shapes (stamped in various forms from sheets of dough) are known as the macaroni products. The Eastern world rarely consumes macaroni products. Chapattis (thin, unleavened pancakes) are a common food product in India and Pakistan. Various forms of wet or dried noodles are consumed in South Asia, China, and Japan (Irvine, 1988).

The perception of pasta consumption is changing. Pasta is losing its cheap and filling image. Once thought of as unhealthy, carbohydrate-rich, and starchy, pasta now is considered an excellent low-fat protein source that is convenient and nutritional (Giese, 1992). Pasta's versatility, long shelf life in dry form, availability in numerous shapes and sizes, high digestibility, good nutrition, and relatively low cost are attractive to the consumer. As people become more concerned about their health, pasta becomes more important in helping them to improve their diets. Many countries produce, export, and import pasta products. The largest pasta-producing countries and their *per capita* consumption are listed in Table 2. Tables 3 and 4 list the largest pasta exporting and importing countries, respectively (Pasta Journal, 1989).

Table 2. Largest pasta-producing countries (Pasta Journal, 1989; Buhler-Miag: used with permission)

Rank	Country	*Per capita* consumption (kg)	Production (Mill. kg year^{-1})
1	United States	7.7	1814
2	Italy	25.0	1814
3	Former USSR	5.4	1406
4	Brazil	3.2	499
5	Egypt	6.8	363
6	Turkey	5.0	318
7	Mexico	3.6	295
8	France	6.4	272
9	Argentina	7.7	250
10	West Germany	4.5	250
11	Venezuela	13.2	240
12	Peru	10.0	213
13	Spain	4.1	181
14	Japan	1.4	150
15	Canada	4.5	136

In the United States, the estimated pasta consumption *per capita* for 1991 was 8.6 kg, almost twice the consumption in 1975 (Pasta Journal, 1993a). The projection for pasta consumption *per capita* for the year 2000 is estimated to be 13.6 kg (Pasta Journal, 1993a). The current United States production (1.8 million tons) of dry and packaged pasta is almost 2.8 times the production in 1970. A five year's study conducted by the NPD Group, Incorporated, a Chicago-based research firm, indicated that pasta is consumed by different age and household groups (Pasta Journal, 1993b). The study also showed an increased consumption of macaroni, lasagna, noodles, spaghetti, ravioli, and macaroni and cheese, and a decrease in pasta salad eating.

In 1991, the US Department of Agriculture (USDA) and Food and Drug Administration developed a food guide pyramid to help select foods and meals that make up a nutritious diet. The base of the pyramid included grain-based food, such as pasta, breads, and cereals (Fig. 1) (USDA, 1991). Pasta is one of the most popular, versatile, and nutritious foods in the world.

Table 3. Ten largest pasta exporting countries (Pasta Journal, 1989; Buhler-Miag: used with permission)

Rank	Country	Export (Mill. kg year^{-1})
1	Italy	370
2	Canada	32
3	Turkey	25
4	United States	21
5	France	20
6	Spain	20
7	Greece	10
8	Poland	10
9	Argentina	10
10	Romania	9

Table 4. Ten largest pasta importing countries (Pasta Journal, 1989; Buhler-Miag: used with permission)

Rank	Country	Import (Mill. kg year^{-1})
1	Former USSR	200
2	United States	102
3	France	97
4	England	45
5	Japan	33
6	West Germany	30
7	Algeria	25
8	Canada	11
9	Holland	10
10	Switzerland	6

Couscous

Couscous, a paste product made from mixing semolina with water, is considered one of the major food staples in North African countries, such as Egypt, Libya, Tunisia, Algeria, and Morocco. Couscous is made from pearl millet in Senegal and maize in Togo (Kaup and Walker, 1986). An estimated 10% of durum wheat in the Near East is used to manufacture couscous (Williams, 1985). Traditionally, couscous is made in small quantities in the home. Commercially, couscous can be produced continuously at 500 kg per hour (Seiler, 1982). The quality of durum wheat or semolina required for making good couscous is probably similar to that of other paste products, but this needs further investigation (Kaup and Walker, 1986).

Kernel hardness and semolina protein, gluten, and particle size are important to the quality of couscous (Quaglia, 1988). Semolina's small particle size contains more damaged starch, which absorbs more water that may be important to the absorption of steam by couscous. The steps required to make commercial couscous are the same as traditional couscous (Kaup and Walker, 1986). Manufacturing couscous requires seven steps: (i) blending: semolina is mixed with water or a saltwater; (ii) agglomeration: semolina particles are combined into a mixture; (iii) shaping: the particulate mixture is reduced and shaped; (iv) steaming: the resulting granulate is precooked; (v) drying: the coarse agglomerates are dried; (vi) cooling: the products are cooled to ambient temperature; (vii) grading: the couscous is separated into fine, medium, and coarse; (viii) storage: the couscous is stored until packaged.

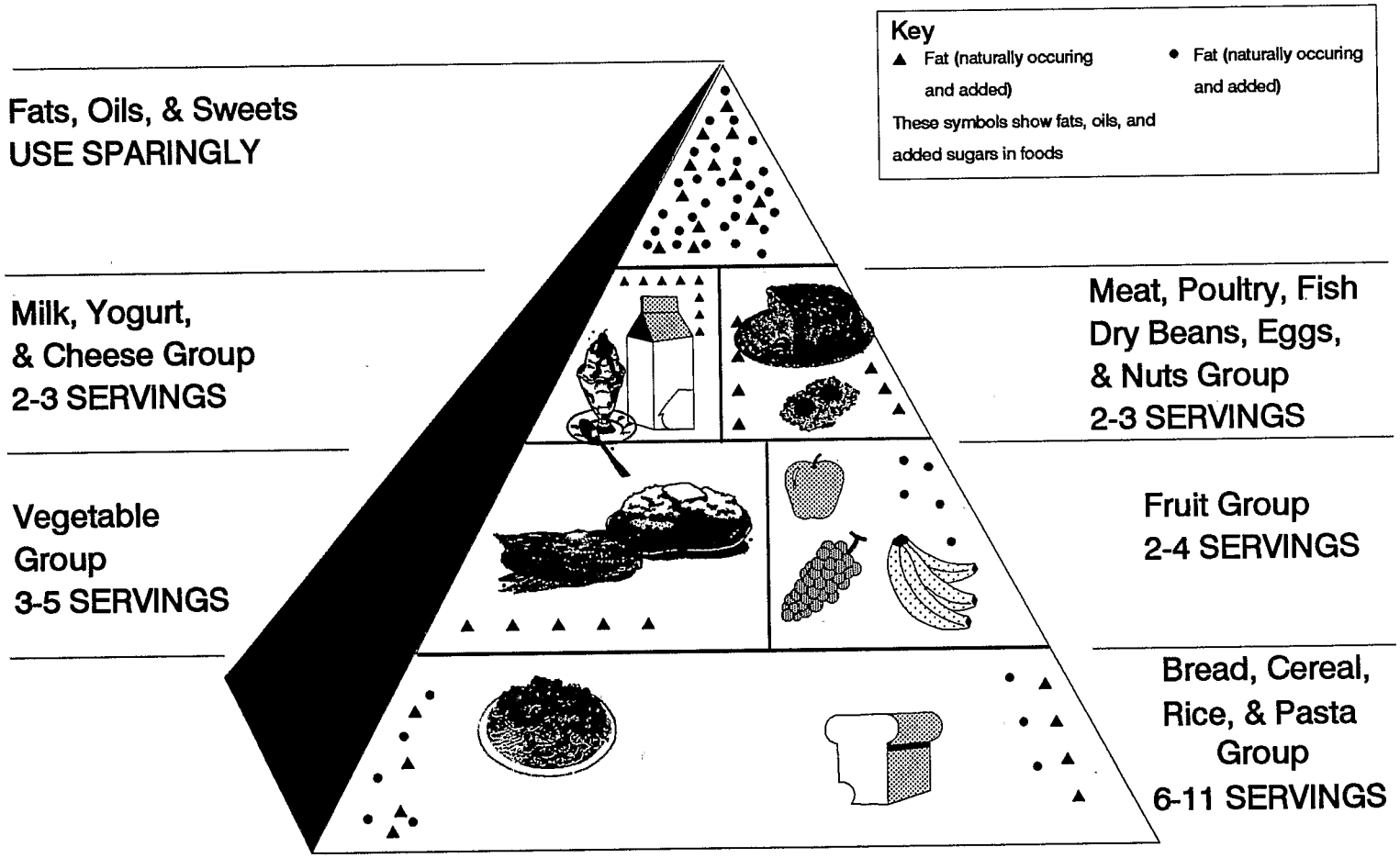

Fig. 1. Food guide pyramid: A guide to daily food choices (USDA, 1991).

Good quality couscous should have the following characteristics: absorbs sauce well, uniform particle size, individual particles maintain their integrity during steaming or sauce application, and particle is nonsticky. All these factors affect the taste of couscous. Couscous is a versatile food in North Africa that is served in many different ways and with a variety of other foods.

Bulgur

Bulgur, a non-paste durum wheat product, is used as a main dish or as one of the ingredients in most food consumed in Turkey, Syria, Jordan, Lebanon, and Egypt. Bulgur is made from different kinds of wheats. However, durum is preferred because of its hardness and amber colour. An estimated 15% of durum wheat in the Near East is used to make bulgur (Williams, 1985). Bulgur made at home or commercially follows the same steps with one exception: hard red and durum wheats are used for commercial bulgur; only durum wheat is used for homemade bulgur.

The steps in bulgur making include: (i) the wheat is cleaned and cooked to gelatinize the starch; (ii) the cooked product is cooled, dried, moistened, peeled to remove the bran (optional), redried, and cleaned by winnowing; (iii) the wheat is milled into three or four size grades: coarse, fine, very fine, and flour (Dick and Matsuo, 1988).

Coarse bulgur is cooked similar to rice. Fine bulgur is mixed with meat or poultry. Kibbeh, a mixture of bulgur and meat, can be cooked in different ways and is one of the most popular foods consumed throughout the Middle East. *Falafel*, a deep fried mixture of faba beans and bulgur, is a traditional food for both the rich and the poor in the Middle East. Salads, such as *Tabouleh*, also can be prepared from bulgur.

Frekeh

Frekeh, a non-paste durum wheat product, is a staple food in North Africa and the Middle East especially Syria. Frekeh is a parched green wheat that is used the same way as rice, bulgur, and couscous. Frekeh is either boiled or steamed and served with lamb or poultry. Best frekeh is made from the largest, hardest, and greenest grains. Therefore, durum wheat, especially varieties with large kernels, is the most suitable wheat for making frekeh. In the Near East, 2% of durum wheat is used to make frekeh (Williams, 1985).

Williams and El-Haramein (1985) describe the economic importance of frekeh and its production. In contrast to bulgur, frekeh making is a localized village industry. In many villages in Northwestern Syria, frekeh is one of the most important sources of income. It is a small industry, but an estimated 200 to 300 thousand tons of frekeh are made every year in the Middle East.

The season for making frekeh is only one to two weeks when the durum wheat is in the filling stage. The wheat is swathed, hand gathered, and laid in the sun to dry partially. The heads are laid to face the wind and are elevated by laying across a piece of metal or a row of stones. The swath is scorched by flames to burn off the awns and leafy material. All heads will fall to one place because of their orientation. Sun and light wind are necessary to dry the charred heads, which are separated from the ash, charred awns, and leaves by winnowing in the wind. The heads are either hand (small scale) or mechanically (large scale) threshed to separate the grain from the chaff. Finally, the grain is stored in bulk before it is bagged.

Durum wheat bread

Durum flour is used to some extent in bread production, especially in Europe (Kent-Jones and Amos, 1947). Durum wheat is used to a larger extent in bread production in the Near East, Middle East, and Italy (Williams *et al.*, 1984; Williams, 1985). Depending on the country and the amount of blend from other flour, several types of bread are made from durum wheat. Two-layered bread, *Khobez,* is the most popular bread in Syria, Lebanon, and Jordan. In Egypt, two-layered bread is called *Baladi* and

Shami. Single-layer bread also is popular, including *Tannur* and *Saaj* (Syria and Lebanon), Mountain bread and *Markouk* (Lebanon), and *Mehrahrah* (Egypt) (Dick and Matsuo, 1988). In Turkey, flat bread, *Tandir Ekmegi*, is made from durum wheat. Thirty percent and 18% of durum wheat in the Near East is used to make two-layer and single-layer breads, respectively (Williams, 1985).

Several kinds of bread are made in Italy from durum wheat, depending on the shape and the region (Sada, 1982; Quaglia, 1988). The common breads include *Fresedde* in the province of Bari; *Frasella* in the province of Foggia; *Frasedda*, *Frisedda*, and *Frisa* in the province of Salerno. A round and flat bread, *Cafone*, is produced in Bari. A wheel-shaped durum wheat bread, *Rote*, is produced in the Bari and Foggia provinces. *Sckanate* is a large durum bread typically made in Minervino, Altamura, Bitonto, and Gargano.

Although some countries use durum wheat to produce different kinds of bread, the proper bread making quality has restricted its wider use. Based on the characteristics of certain proteins in the kernel, the differences between common wheat and durum wheat can be attributed largely to their gluten protein properties, with durum wheat normally having weaker gluten than bread wheat. However, the development of strong gluten durum cultivars has improved the cooking quality of pasta products and improved the bread baking quality. *Vic*, which is a strong gluten durum wheat cultivar, has higher flour absorption and only 10% lower loaf volume than the hard red spring wheat flour used as a control (Josephides, 1982).

Quick and Crawford (1983) evaluated two strong gluten durum cultivars and one weak gluten cultivar for quality and leavened pan bread. The strong gluten durum wheats were superior in flour absorption; equal in test weight, flour protein, and dough mixing pattern; and inferior in flour extraction and dough handling characteristics, compared to the hard red spring wheat included in the experiment. The strong gluten durums were superior to the weak gluten durum and nearly equal to the hard red spring wheat in overall evaluation. Dexter *et al.* (1981) compared 28 Canadian durum wheats to 35 common wheats for mixing properties and baking quality. They found that durum wheats possessed shorter bread dough farinograph mixing times and were poorer in baking quality.

The desirability of developing a durum wheat with satisfactory bread baking characteristics and acceptable pasta quality should not be diminished, considering the potential benefit in the international market. Quick and Crawford (1983) reported a dual-purpose durum wheat would have distinct advantages in situations where the processor could purchase one source of raw material for both bread flour and pasta semolina or when weather and disease cause shortage of hexaploid wheat.

Other products

In North America, large kernels of durum wheat are used to make a puffed durum wheat ready-to-eat breakfast cereal. In the Middle East, *Mamuneih* is consumed as a hot cereal breakfast made from semolina cooked in water with butter and sugar. In the same region, several desserts are made from semolina. Deep fried semolina dough (*Mushabak*), baked semolina dough (*Hariseh*), baked semolina mixture with vegetable oil, sugar, and nuts (*Halva*) are common desserts in Syria, Lebanon, and Jordan. In Germany, *kugel* is a sweet noodle pudding that is used as a dessert and now is being marketed in North America.

Conclusion

The trend worldwide is to increase the consumption of durum wheat products. Pasta, bread, and all other food from grains are a major group of healthy, balanced, and nutritious foods. Research on increasing the yield, production, and disease resistance of durum wheat should continue to be essential. Furthermore, the quality of durum wheat should not be ignored. Cereal chemists must continue to work on finding more rapid automated analytical tests. There is abundant literature on the association of band 45 with strong gluten and its association with good quality pasta. However, literature about the relationship of this band and bread making from durum wheat flour is lacking. Additional information is needed on couscous and bulgur production. Breeders, pathologists, cereal

chemists, and molecular geneticists should continue to work as a team to insure high yielding, good quality durum wheat for the international market.

References

Banasik, O.J. (1981). Pasta processing. *Cereal Foods World*, 26: 166-169.

Byerlee, D. (1981). *Wheat facts and trends*. Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), México City, México.

Cantrell, R.G. (1987). Breeding and genetics of durum wheat. In: *Plant Breeding Reviews*, Janick, J. (ed.). Van Nostrand Reinhol Co., New York, Vol. 5, pp. 11-40.

Dalrymple, D.G. (1978). *Development and spread of high-yielding varieties of wheat and rice in the less developed countries*. Foreign Agric. Econ. Rep. 95, Dept. Agric., Washington, DC.

Dexter, J.E., Matsuo, R.R., Preston, K.R. and Kilborn, R.H. (1981). Comparison of gluten strength, mixing properties, baking quality and spaghetti quality of some Canadian durum and common wheats. *Can. Inst. Food Sci. Technol.*, 14: 108-111.

Dick, J.W. and Matsuo, R.R. (1988). Durum wheat and pasta products. In: *Wheat Chemistry and Technology*, Pomeranz, Y. (ed.). AACC, St. Paul, Minnesota, Vol. II, pp. 507-547.

Giese, J. (1992). Pasta: New twists on an old product. *Food Technol.*, February, 1992, pp. 117-126.

Hanson, H., Borlaug, N.E. and Anderson, R.G. (1982). *Wheat in the third world*. Westview Press, Boulder Co.

International Wheat Council (1982). *The world durum wheat situation*, Secretariat Paper 12. The Council, London.

International Wheat Council (1991). *World production of durum wheat*. The Council, London.

Irvine, G.N. (1988). Durum wheat and pasta products. In: *Wheat Chemistry and Technology*, Pomeranz, Y. (ed.). AACC, St. Paul, Minnesota, Vol. II, pp. 777-797.

Josephides, C.M. (1982). *Studies on gluten strength and quality Triticum turgidum L. var durum*. M.S. Thesis, North Dakota State University, Fargo, ND.

Kaup, S.M. and Walker, C.E. (1986). Couscous in North Africa. *Cereal Foods World*, 31: 179-182.

Kent-Jones, D.W. and Amos, A.J. (1947). *Modern Cereal Chemistry*, 4th Ed. Northern Publishing Co., Liverpool, England.

Pasta Journal (1989). Europe, 1992, & the US food sectors. *Pasta J.* Nov./Dec., 71: 33-36.

Pasta Journal (1993a). Pasta consumption, production, import statistics. *Pasta J.*, Jan./Feb., 75: 11-13.

Pasta Journal (1993b). Pasta is growing strong. *Pasta J.*, May/June, 75: 16-17.

Quaglia, G.B. (1988). Other durum wheat products. In: *Durum Chemistry and Technology*, Fabriani, G. and Lintas, C. (eds). AACC, St. Paul, Minnesota, pp. 263-282.

Quick, J.S. and Crawford, R.D. (1983). Bread baking potential of new durum wheat cultivars. In: *Proc. 6th Int. Wheat Genetics Symp.* Kyoto, Japan, pp. 851-856.

Sada, L. (1982). Grano e pane della Puglia. *Panif. Pastic.*, 10: 47-45.

Seiler, W. (1982). Il couscous. *Molini Ital.*, 33: 417-421.

Srivastava, J.P. (1984). Durum wheat: its world status and potential in the Middle East and North Africa. *Rachis*, 3: 1-8.

USDA (1991). The Food Guide Pyramid. *Home and Garden Bull.*, number 252.

Williams, P.C. (1985). Survey of wheat flours used in the Near East. *Rachis*, 4: 17-20.

Williams, P.C. and El-Haramein, F.J. (1985). Frekeh making in Syria, small but significant local industry. *Rachis*, 4: 25-27.

Williams, P.C., Srivastava, J.P., Nachit, M. and El-Haramein, F.J. (1984). Durum wheat quality evaluation at ICARDA. *Rachis*, 3: 30-32.