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Aquaculture feed manufacturing practice within the North African region

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SUMMARY - For the purposes of this paper the North African region includes Algeria, Egypt, Libya, Morocco, Mauritania, and Tunisia. However, of these countries only Egypt, and to a lesser extent Morocco and Tunisia produce significant quantities of aquaculture products (i.e., total aquaculture production within these countries in 1996 being reported by FAO as 75,837 mt, 2,300 mt and 1,481 mt respectively; FAO AQUASTAT-PC, April 1998). By contrast, aquaculture production within Algeria (322 mt), Libya (100 mt) and Mauritania (0 mt) is currently only of minor importance compared with capture fisheries. Moreover, at present commercial aquafeed manufacture is not currently practised either in Tunisia or Morocco; these countries depending upon the use of imported pelleted aquafeeds for the intensive culture of marine finfish species (i.e., European seabass/Gilthead seabream), apart from the local preparation and use of farm-made aquafeeds for other species. Egypt alone currently produces about 94% of the total aquaculture production within the North African region, and as such the resident aquafeed manufacturing industry offers great potential for further expansion; most aquaculture feed ingredients being locally available at reasonable prices. It is perhaps not surprising therefore that during recent years a growing number of commercial/government feed mills have been constructed to meet the increasing demand for aquafeeds. It is estimated that total aquafeed production in Egypt was about 20,000 mt in 1996; these compounded aquafeeds mainly being used for the feeding and production of tilapia, carp and mullet within semi-intensive farming systems. In addition to industrially manufactured aquafeeds, there is also a limited production of simple farm-made aquafeeds.

Key words: Aquaculture feeds, resources, manufacturing, North Africa, Egypt, Tunisia, Morocco.

RESUME - "Fabrication d'aliment aquacole dans la région d'Afrique du Nord". Pour les besoins de cet article, la région d'Afrique du Nord comprend l'Algérie, l'Égypte, la Libye, le Maroc, la Mauritanie et la Tunisie. Cependant, parmi ces pays uniquement l'Égypte, et à un moindre degré le Maroc et la Tunisie, produisent des quantités significatives de produits aquacoles (c'est-à-dire que la production totale de l'aquaculture dans ces pays en 1996 a été selon la FAO de 75 837 tm, 2 300 tm et 1 481 tm respectivement ; FAO AQUASTAT-PC, avril 1998). Par contre, la production aquacole en Algérie (322 tm), Libye (100 tm) et Mauritanie (0 tm) est actuellement d'importance mineure comparée aux captures de la pêche. En plus, la fabrication commerciale d'aliment aquacole n'est implantée actuellement ni en Tunisie ni au Maroc ; ces pays dépendent de l'utilisation d'aliment granulé importé pour l'élevage intensif d'espèces de poissons marins (à savoir le bar/dorade), à part la préparation et l'utilisation locales d'aliments aquacoles fabriqués sur la ferme pour d'autres espèces. L'Égypte à elle seule apporte actuellement environ 94% de la production aquacole totale pour la région d'Afrique du Nord, et ainsi l'industrie de l'aliment aquacole du pays présente un grand potentiel pour une expansion ultérieure ; la plupart des ingrédients de ces aliments étant disponibles localement à des prix raisonnables. Il n'est donc pas surprenant que pendant ces dernières années un nombre grandissant d'usines commerciales/gouvernementales aient été construites pour faire face à la demande croissante d'aliment aquacole. On a estimé que la production totale d'aliment aquacole en Égypte était d'environ 20 000 tm en 1996 ; ces aliments composés étant principalement utilisés pour la nutrition et la production de tilapia, carpe et mullet en systèmes d'élevage semi-intensifs. En plus des aliments aquacoles fabriqués industriellement, il existe également une production limitée d'aliments simples élaborés sur la ferme.

Mots-clés : Aliments aquacoles, ressources, fabrication, Afrique du Nord, Égypte, Tunisie, Maroc.

Introduction

The aquaculture industry is relatively new in the North African region, with the exception of Egypt where it has been practised since the beginning of recorded human history (Bardach *et al.*, 1972; Autin, 1997). At present, fish production from natural fisheries covers the consumers' demand in Libya, Tunisia, Algeria, Morocco and Mauritania (Arab Union for Fish Producers; AUFP, 1997). However, Egypt imports a substantial amount of fish annually (General Authority for Fisheries Resources Development; GAFRD, 1997).

Although aquaculture development within most North African countries has been slow, considerable attention has been given to aquaculture production in Egypt over the past decade (El-Sayed, 1996); total aquaculture production within the region in 1995 amounting to 65,450 mt and Egypt alone accounting for 94% of the total production, with the remainder (6%) mainly being produced by Morocco and Tunisia (AUFPP, 1997).

Since the success of finfish aquaculture production depends upon the provision of suitable nutrient inputs (either in the form of aquafeeds or fertilizers), it follows therefore that information on the available feed and fertilizer resources (including manufactured aquafeeds) is essential for the further development of the sector. The present review attempts to shed some light on the current status of aquafeed manufacturing practice within the North African region.

As mentioned previously, aquaculture production in Libya and Mauritania is currently negligible in terms of production (FAO/System of Information for the Promotion of Aquaculture in the Mediterranean; SIPAM, 1996). Similarly, aquaculture production in Algeria is also very low, with production ranging between 150-450 mt/year from 1991-1995, with carps representing more than 80% of total production. These species are currently being reared semi-intensively mainly within agricultural dams and irrigation canals, with fish production mainly being achieved through the use of fertilizers and farm-made aquafeeds. Only Egypt, and to a lesser extent Morocco and Tunisia, currently practice aquaculture to any great extent. Consequently, this review will restrict itself to describing the aquaculture feed manufacturing practices within these three countries.

Tunisia

Aquaculture is developing slowly in Tunisia, with production fluctuating between 500-880 mt/year during 1991-1995, and reaching 1,140 mt in 1994 (FAO/SIPAM, 1996; Fig. 1). European Seabass and seabream are currently the main farmed species.

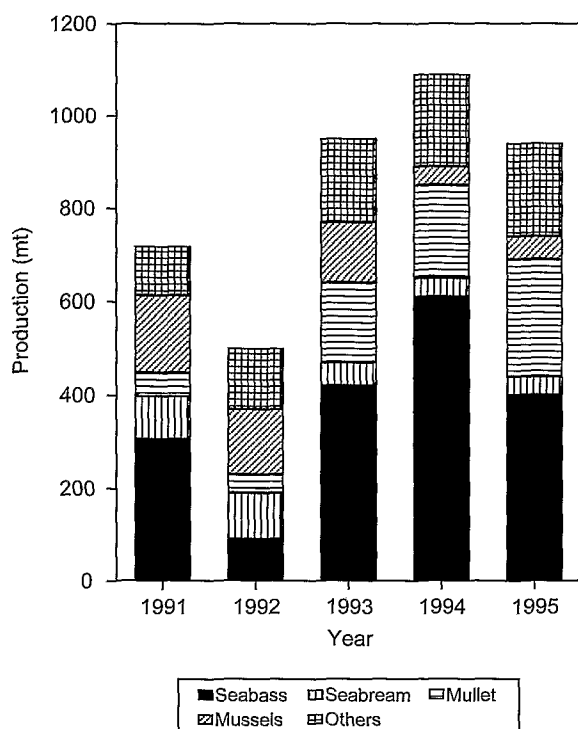


Fig. 1. Aquaculture production in Tunisia during 1991-1995.

The consumption of aquafeeds in Tunisia is currently estimated to be about 3,000 mt/year, of which about 1,500 mt consists of industrially compounded aquafeeds for seabream/seabass imported

from Spain and France (for intensive cage and pond culture), and the remainder being in the form of farm-made aquafeeds. Typical farm-made formulations include the use of fresh sardines, fishmeal and soybean meal as dietary protein sources (used at a ratio of 50:40:10) mixed with dietary energy sources (i.e., wheat bran, olive oil and fish oils) and a vitamin/mineral premix; the ingredients being mixed in 50 kg batches and then pelleted within small feed mills (SIPAM, pers. comm.).

Morocco

The situation of the aquaculture industry in Morocco is quite similar to that of Tunisia, although aquaculture production sharply increased in 1995 compared to 1994, with the European seabass, Gilthead seabream and oysters representing more than 70% of total aquaculture production (Fig. 2.). In addition to the above species, carp culture is currently expanding in many areas of Northern Morocco, especially within rain waters stored behind agricultural dams and within irrigation/drainage canals.

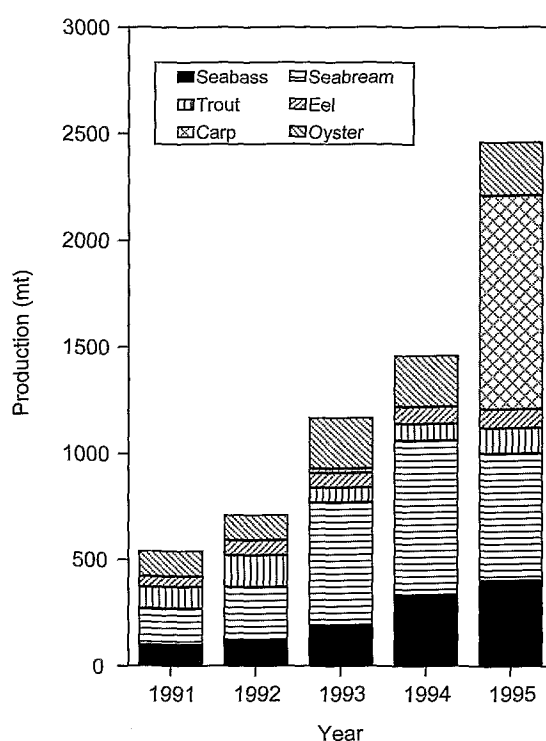


Fig. 2. Aquaculture production in Morocco during 1991-1995.

It is estimated that about 3,000 mt of pelleted aquafeeds were consumed in Morocco in 1995 (SIPAM, pers. comm.), of which about 90% was imported (mainly from Spain), with the remainder being in the form of farm-made aquafeeds; the production techniques for the latter being similar to those employed in Tunisia.

Aquaculture feed resources in Tunisia and Morocco

Aquaculture feed ingredients

The major aquaculture feed ingredients available in Tunisia and Morocco are listed in Table 1. Most of these ingredients are locally available at reasonable prices as a result of government subsidies, especially in Tunisia. However, this situation has also created a black market in Tunisia (FAO, 1983).

Table 1. Major aquaculture feed ingredients available in Tunisia and Morocco

Ingredient	Origin
Fishmeal (sardine)	Local
Fish by-catch	Local
Poultry by-product	Local
Fishmeal	Imported
Soybean meal	Imported
Cottonseed meal	Local/import
Wheat bran	Local
Barely	Local
Maize	Imported
Brewery waste	Local
Plant oil	Local
Fish oil	Imported/local
Vitamin premix	Imported
Mineral premix	Local

Storage

At present imported aquaculture feeds in Morocco/Tunisia are usually stored for periods varying from 1-4 months at room temperature, usually under well ventilated conditions. By contrast, farm-made aquafeeds are usually either consumed fresh, stored in coolers at 0°C for a few weeks, or stored at room temperature for a few days until fed.

Feeding methods

At present almost all farms in Tunisia/Morocco employ manual feeding methods, irrespective of the intensity of the farming operations used. In addition, carp farmers occasionally fertilize their ponds with organic and/or inorganic fertilizers, especially under semi-intensive culture conditions.

Aquaculture feed manufacturing constraints

From the foregoing discussion it is evident that there is currently no industrial scale compound aquafeed production in either Tunisia or Morocco. It is also unlikely, at least in the short term, that this industry will be developed, because of the following reasons:

(i) Fish production from capture fisheries currently meets the local demand for fishery products with any surpluses usually being exported. This situation limits the potential for further aquaculture development, and in turn, the development of manufactured aquafeeds.

(ii) Low aquaculture production, and consequently low demand for compound aquafeeds.

(iii) Low feasibility and profitability of local aquafeed manufacturing compared to feed imports from neighbouring European countries (Spain and France).

(iv) Competition with the livestock industry for available feed ingredients and feed resources.

(v) Lack of information on the basic nutritional requirements of the major cultured species under local culture conditions.

Egypt

The aquaculture industry is expanding very rapidly in Egypt. About 100,000 feddans (42,000 ha) of freshwater and brackish water are currently used for aquaculture production, with semi-intensive farming systems being the most common production method employed by farmers. This area is expected to increase even further in the future. For example, aquaculture production has increased rapidly from 15,000 mt in 1984 to 76,000 mt in 1996, and currently represents 17.6% of total fish landings in Egypt (Fig. 3). Since feed represents more than 50% of total running costs within most aquaculture projects, it is perhaps not surprising therefore that great attention has been paid to the development of the aquafeed manufacturing sector.

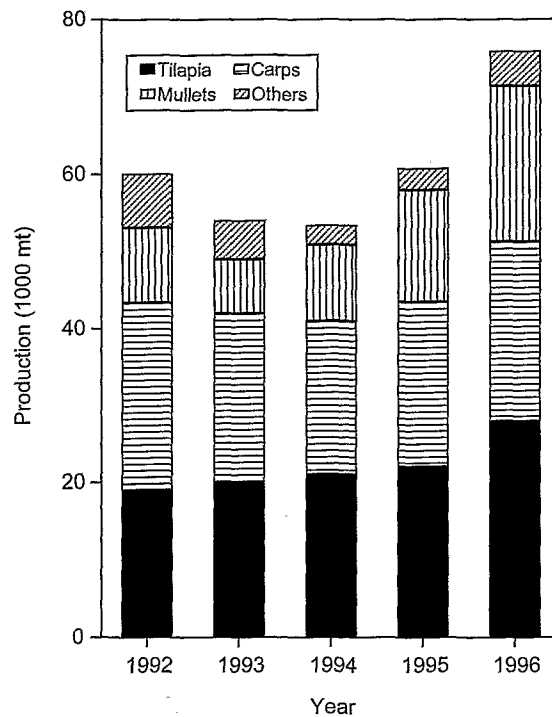


Fig. 3. Aquaculture production in Egypt during 1992-1996.

Aquaculture feed industry

The aquaculture feed industry is relatively new in Egypt. Traditionally, simple feeding techniques have been used by mixing local energy sources such as wheat bran, rice bran or ground corn with protein sources such as fish meal, soybean meal or cotton seed meal at a ratio of 3:1. Generally, the feed mixture is extruded on-farm by using manual feed mills. In some cases the feed mixture is offered to the farmed fish in the form of wet cake.

Modern aquafeed manufacturing started in Egypt in the early 1990s, with two medium-scale mills constructed by GAFRD (Table 2). The first extruder was installed at Bersiq (Behaira Governorate); the mill producing about 5,000 mt/year (one shift/day) or 10,000 mt (2 shifts/day) of sinking pellets, depending on the farmers' demand. The other feed mill was built at Manzala (Dakahlia Governorate) with a production capacity of about 14,000 mt/year. Two other small aquaculture feed mills were installed by the Ministry of Defense at El-Tall El-Kabeer (Ismailia) and at the Suez Canal University (Ismailia) with a production capacity of about 15,000 and 1,500 mt/year, respectively. Another small aquaculture feed extruder has also been constructed at the Maryut Fish Farming Company (MFFC), near Alexandria, with a production capacity of about 1,000 mt/year (2 shifts/day) of floating pellets. On the basis of the above information it is estimated that total aquafeed production in Egypt was about 20,000 mt in 1996.

Table 2. Major aquaculture feed mills in Egypt

Feed mill and authority	Production capacity (mt/h)	Current production (mt/y)	Working shifts
Bersiq, Bahaira (GAFRD)	3.00	5000	1
Manzala, Dakahlia (GAFRD)	4.00	9000	1
El-Tall El-Kabeer, Ismailia (Ministry of Defense)	5.00	5000	
Alexandria (MFFC)	0.25	500	1
Suez Canal University, Ismailia	0.40	500	2
Total		20000	2

One of the main technical problems facing the aquafeed manufacturing industry in Egypt is the difficulty of producing larval feeds. Currently, the mills only produce fish pellets of 2-4 mm diameter which are used exclusively for fattening or grow-out. In addition, spare parts for the feed mills are difficult to obtain in the country and so have to be imported. However, the involvement of the private sector in the aquaculture feed industry is expected to overcome many of these obstacles in the near future. In general, the bulk of the manufactured aquafeeds produced in Egypt are produced for omnivorous/herbivorous finfish species, such as tilapia, mullet and carps; these species generally being reared at low densities within semi-intensive pond farming systems, and to a much lesser extent within intensive tank or cage farming systems. In addition, small quantities of aquafeed are also produced for other farmed species such as the African catfish, European seabass, Gilthead seabream, shrimp and freshwater prawns.

Aquaculture feed resources and constraints

The source, origin and prices of feed ingredients commonly used for the production of aquafeeds in Egypt are listed in Table 3. Since most of these ingredients are locally available in large quantities and at low prices, it follows therefore that the basic conditions for manufacturing aquafeeds within Egypt are very favourable. However, despite this there are several constraints which currently hamper the further development of the aquafeed manufacturing industry in Egypt, including:

(i) The lack of quality control procedures/measurements. The lack of quality control procedures/measurements has led to the production and marketing of aquafeeds and feed ingredients (such as fishmeal) with varying and often poor quality.

(ii) The lack of information concerning the chemical composition and nutritional value of most of the feed ingredients used within compound aquafeeds, and in particular concerning their proximate, amino acid, fatty acid, and mineral composition, and antinutrient content.

(iii) The increasing prices of imported raw feed materials such as fishmeal, soybean meal, and yellow corn.

(iv) The lack of information on the basic dietary nutrient requirements of the major cultured fish species, and consequent absence of specific aquafeed formulations for each individual species; the net result being the use of a single fish feed formulation or diet for different fish species under different farming conditions.

(v) The lack of adequate extension services and knowledge concerning aquafeed manufacturing technology. At present the majority of small-scale fish farmers in Egypt are not aware of the existence of modern aquafeed manufacturing and feeding methods; the bulk of these farmers still employing relatively simple feeding methods based on the use of unprocessed feed ingredients or agricultural wastes. Moreover, as in many other parts of the world, these farmers are generally of the opinion that the cost of manufactured pelleted feeds are too high and do not trust the quality of these off-farm prepared pelleted feeds.

(vi) Poor processing and handling techniques. There is an urgent need to improve the processing methods employed within the country for the production of key feed ingredient sources, and in particular of animal protein sources (i.e., fishmeal, shrimp meal, poultry by-products, blood, meat and bone, etc.), so as to improve ingredient quality, ingredient shelf life, and the nutritional value of these key ingredient sources for aquaculture species.

(vii) Poor storage of feed ingredients and finished aquafeeds. There is also an urgent need to improve the storage methods employed by feed ingredient suppliers, feed manufacturers, and farmers, so as to preserve the nutrient quality and content of ingredients/finished aquafeeds prior to feeding.

(viii) The lack of promotion for aquaculture and aquafeed manufacture, and the need to better advertise/promote the sector so as to encourage investment by the private sector and by so doing further stimulating the development of the aquafeed manufacturing sector.

Table 3. Sources and prices of feed ingredients commonly used in animal feed manufacturing in Egypt in 1996

Ingredient	Origin	Price (US \$/mt)
Animal sources		
Blood meal	Local	250
Fishmeal	Local	500
Fishmeal	Imported	900
Gelatin	Local	4500
Meat meal	Imported	500
Meat and bone meal	Local	300
Poultry by-product meal	Local	300
Shrimp meal	Local	250
Plant sources		
Cottonseed meal (with hulls)	Local	170
Cottonseed meal (without hulls)	Local	270
Yellow corn	Imported	200
Corn gluten (grade 1)	Local	230
Corn gluten (grade 2)	Local	150
Corn starch	Local	300
Rice bran	Local	150
Rice mill run	Local	150
Soybean meal	Local	270
Soybean meal	Imported	300
Coarse wheat bran	Local	120
Fine wheat bran	Local	170
Others		
Cod liver oil	Imported	1000
Fish (sardine) oil	Local	350
Corn oil	Local	1000
Vitamin and mineral premix	Imported	8000
Vitamin and mineral premix	Local	7000

Prospects

The private sector in Egypt has recently been attracted to invest in aquaculture, and a number of medium and large-scale aquaculture development projects are currently under construction. In particular, the government has been encouraging investment in aquaculture and aquafeed

development through: (i) the provision of loans at low interest rates; (ii) the provision of extension services and consultations; and (iii) the establishment of training programmes for aquaculture feed technicians and specialists.

However, as mentioned previously, tremendous efforts will still be required to overcome the above mentioned constraints so as to ensure the further development and growth of the aquafeed manufacturing sector in Egypt.

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