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Feasibility of using Mediterranean rainfed crops in poultry rations

M.T. Farran*, S.K. Yau*, N.J. Daghir*, G.W. Barbour** and N.N. Usayran***

*Animal and Veterinary Science Dept., American University of Beirut, P.O. Box 110236, Beirut (Lebanon)

**Poultry Science Department, Lebanese Agricultural Research Institute

P.O. Box 287, Zahle'/Tel Amara, Beqa'a, Lebanon (Lebanon)

***Animal Production Department, Lebanese University, 1102 2040, Beirut, (Lebanon)

Abstract. Large fluctuation in market price and availability of conventional poultry feed ingredients in the Mediterranean region is caused by the global shift towards the production of bio-fuel and further exacerbated by the reduced water availability caused by climatic changes especially in southern Mediterranean countries. Poultry researchers in the region are urged to consider domestic rainfed crops as alternatives to corn and soybean meal. In line with this strategy, this paper summarizes the work conducted at the American University of Beirut in the fields of agronomy and poultry nutrition on barley, vetch and safflower and presents the economic feasibility of using such rainfed crops. A recent yield survey in different locations in Lebanon and in rainy years or with necessary supplementary irrigation in years with irregular rainfall distribution, showed that barley, vetch, safflower and wheat produce 3.8, 3.2, 3.3 and 4.9 t/hectare, respectively. Properly detoxified vetch could be incorporated in broiler and layer rations at 60%. In broiler diets, barley could be used at 25% with enzyme supplementation whereas safflower meal substituted 75% of soybean meal in diets supplemented with lysine and methionine. An economic feasibility study showed that only local barley and safflower meal could be incorporated in practical least cost rations. Moreover, safflower increases the production value by US\$ 70/hectare over non-subsidized wheat.

Keywords. Barley – Vetch – Safflower – Poultry rations – Feasibility study.

Faisabilité de la valorisation en aviculture de certaines productions méditerranéennes cultivées en pluvial

Résumé. De larges fluctuations des prix de marché et une disponibilité d'ingrédients conventionnels comme aliment avicole dans la région méditerranéenne sont les conséquences du changement global vers la production de biofioul, encore aggravée par une disponibilité réduite d'eau causée par les changements climatiques en particulier dans les pays du Sud de la Méditerranée. Les chercheurs en matière d'aviculture de la région sont ainsi amenés à prendre en compte les productions nationales menées en pluvial en tant qu'alternatives à la farine de maïs et de soja. Dans le cadre de cette stratégie, cet article résume les travaux menés à l'Université Américaine de Beyrouth dans le domaine de l'agronomie et la nutrition avicole concernant l'orge, la vesce, et le carthame, et présente la faisabilité économique de la valorisation de ces cultures non irriguées. Une étude de terrain récente dans différents sites au Liban et lors d'années pluvieuses ou avec la nécessaire irrigation d'appoint lors des années à distribution irrégulière des précipitations, a montré que l'orge, la vesce, le carthame et le blé produisent 3,8, 3,2, 3,3, et 4,9t/hectare respectivement. La vesce, correctement détoxifiée, pourrait être incorporée dans les rations pour poulets et pondeuses à hauteur de 60%. Pour les régimes des poulets, l'orge pourrait être utilisée à 25% avec supplémentation d'enzymes tandis que la farine de carthame peut substituer 75% de la farine de soja dans les rations supplémentées en lysine et méthionine. Selon une étude de faisabilité économique, uniquement la farine d'orge et de carthame cultivés localement pourraient être incorporés dans des rations pratiques à moindre coût. De plus, pour le carthame la valeur de la production est augmentée de US\$ 70/hectare par rapport au blé non subventionné.

Mots-clés. Orge – Vesce – Carthame – Aliments des volailles – Etude de faisabilité.

I – Introduction

The worldwide elevated market price and the availability issue of conventional poultry feed ingredients, mainly corn and soybean meal (SBM), is caused by the global shift towards the production of bio-fuel and further exacerbated by the reduced water availability caused by climatic changes, especially in the southern Mediterranean countries. Since feed constitutes 60-70% of the total cost of producing eggs and poultry meat, it is very important that poultry researchers in developing countries consider the use of locally produced feedstuffs to reduce the costs of production. According to FAO and the Ministry of Agriculture of Lebanon (2007), cereals and legumes constituted 69,600 and 7,000 ha (50% rainfed) and represented 5 and 2% (\$69 and 25 million) of the total agricultural commodities production values in Lebanon, respectively. Taking into consideration their socioeconomic benefits in the rural areas, the use of domestic rainfed crops in contrast to irrigated crops, as alternatives to conventional feedstuffs, may further contribute to reduced costs. The objective of this paper is to review the work undertaken in the American University of Beirut in the fields of agronomy and poultry nutrition on locally produced barley (*Hordeum vulgare*), vetch (*Vicia sativa*), and the meal of safflower (*Carthamus tinctorius* L.) and to discuss the economic feasibility of producing such rainfed crops and their incorporation in poultry rations.

II – Agronomic aspects

Barley is a crop widely grown in arid and semi-arid areas of West Asia and North Africa where barley grain, straw and stubble are the traditional and predominant feed for sheep. The relative earlier flowering and maturity of barley allows it to escape heat and drought, and yield better than wheat in the drier areas. In the last two decades, efforts have been spent to replace the non-sustainable barley monoculture commonly practiced in the region by barley-legume rotation. Introduction of improved varieties of forage legumes adapted to dry areas, like common vetch, proved to be economically beneficial and would improve the sustainability of the farming system (Yau *et al.*, 2003). Safflower is a drought-tolerant oil-seed crop originating from the eastern Mediterranean. It can be grown profitably in the Bekaa Plain of Lebanon (Yau, 2004). Its deep root system also means that it does not respond to nitrogen application after fertilized crops and thus save the cost on nitrogen fertilization and prevent nitrogen leaching into ground water (Yau and Ryan, unpublished).

Multi-year yield data on the three crops grown under rainfed conditions were collected from different research stations and farmers' fields in the semi-arid region of the Bekaa with an average yearly precipitation of 350-650 mm. The research stations were Agricultural Research and Education Center of the American University of Beirut, and Terbol and Kfardan Research Stations of the International Center for Agricultural Research in the Dry Areas. Farmers' fields from where data were collected are scattered in central and western Bekaa. The different sites were representative of poor, medium and good yielding environments in the Bekaa. Due to its economical importance as a subsidized crop to Lebanese farmers, wheat was included for comparison purposes. The yield of barley in t/ha averaged 3.8, ranging from 1.0 in years with low precipitation to 4.5 in rainy years or in years with irregular rainfall distribution when supplementary irrigation was necessary. Vetch averaged 3.2 t/ha ranging 0.9-4.2 whereas safflower and wheat average yield was 3.3 (0.7-5.0) and 4.9 t/ha, respectively.

III – Poultry feeding

Research on the use of locally produced feedstuffs as replacement for corn and SBM in poultry diets has been reviewed by Daghir (2008). The reduced performance in poultry resulting from feeding raw vetch seeds in excess of 15% (Farran *et al.*, 1995), is mainly due to the presence of β -cyanoalanine in its free and peptide form, vicine and convicine (Farran *et al.*, 2002). Soaking

the seeds in 1% acetic acid at room temperature for 24 hours improved its nutritional value (Farran *et al.*, 2001a) and when fed at 60% of the rations resulted in performance of broilers and layers comparable to those of control birds (Farran *et al.*, 2001b).

Barbour *et al.* (2006) found that the supplementation of an enzyme mixture containing β -glucanase was found to improve the AME of different barley cultivars. More recently, Farran *et al.* (2010a) confirmed this and found that it increased abdominal fat yield. They concluded that levels up to 25% of barley could be incorporated in diets up to market age without affecting broiler performance.

Safflower as a feed ingredient for poultry has been studied for many years. Interest in this protein supplement at this University is recent. Farran *et al.* (2008) showed that extrusion of dehulled safflower kernels resulted in a meal containing 58.4% CP, 11.7% ether extract and 2.59% crude fiber on dry matter basis. This meal was found to be deficient in lysine and methionine but rich in arginine, and its apparent and true ME corrected to zero nitrogen balance were on dry matter basis 2564 and 3010 kcal/kg, respectively (Farran *et al.*, 2010b). Following a broiler feeding trial, the authors concluded that the meal they prepared may replace up to 75% of the SBM in diets supplemented with lysine and methionine.

IV – Economic feasibility study

Although the cultivation of vetch is profitable, it is avoided by most farmers due to its dependency on manual harvesting. The high market price does not allow its inclusion in commercial poultry rations. In broiler rations, 60% vetch substitutes totally SBM and half of the corn, both of which are imported feed ingredients. Thus, the idea of incorporating vetch seeds in poultry rations should not be discarded and be reconsidered when its production cost is reduced by mechanical harvesting. In contrast, locally produced barley could replace corn in least cost broiler rations at a level of 25% with enzyme supplementation. In addition, dehulled extruded safflower meal can substitute up to 75% of the imported SBM (48%) in broiler rations with a supplementation of adequate amounts of lysine and methionine. Safflower is highly competitive with barley and becomes competitive with wheat (+US\$ 70/ha) if the yearly US\$ 6-12 million subsidy is removed. Safflower cultivation is new to Lebanese farmers and a larger scale operation should be appealing to growers as well as to the local vegetable oil processors. The local oil industry is encouraged to seriously consider the utilization of this crop. Needless to mention, the added value of safflower processing will not only provide a good source of edible oil for human consumption and a protein rich meal for animal feeding, but will also have a positive impact on the Lebanese economy since it reduces the demand for imported commodities.

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