Nutritional value of organic raw material for poultry

JUIN HERVÉ[1], FEUILLET DALILA[1], ROINSARD ANTOINE[2], BORDEAUX CÉLIA[3]

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Abstract

The regulation asking for 100 % organic raw materials in poultry feeds will increase the organic protein demand. In order to limit the use of Soya in formulas, it will be necessary to develop alternative organic raw materials. Within the framework of two research programs, three experiments were conducted to evaluate through a known in vivo method the nutritional value of 22 raw materials (analytical and digestibility value). In the group of meals, Soya is the best product in terms of protein (content and utilization). Processing as extrusion and de-hulling improve digestibility of raw material. Animal products may represent alternatives to Soya. There are technical opportunities to reduce the dependence to Soya for poultry feeding; Technology is often requested to improve nutritional value of products, such as linseeds, cannabis and animal products. But there is a need for more specific data about organic raw material to improve sustainability.

Introduction

There is an increase of demand for organic poultry meat in European countries (Le Guen, 2011). However, the development of organic production has to face to two major questions: supply organic feed containing 100% of organic raw materials (in 2015), and reduce the dependence to Soya (Padel & Sundrum, 2006). Organic data tables giving composition and nutritional values are requested by organic poultry producers to improve organic poultry nutrition. So within the framework of two projects, CORE ORGANIC II ICOPP and CASDAR AVIALIMBIO, experiments were conducted to evaluate by *in vivo* method the main available raw materials on the French market. The objectives were 1) to get nutritional values for main organic raw material used in poultry feed, 2) to estimate the variability of the main protein sources and 3) to investigate on new protein sources for organic poultry nutrition.

Material and methods

Three experiments were conducted, according to the referenced method developed by Bourdillon & *al* (1990), and adapted to slow growth strain. In each experiment, 200 day old male broilers (strain JA 657) were raised in one house from D1 to D31, with a commercial organic starter feed. Water and feed were provided *ad libitum* all along the experiment. At D31, based on live weight, groups of 10 birds were selected and allocated, according to a completely randomized factorial design to 1 of the experimental treatments in individual metabolic cages, kept in an environment controlled room. Experimental period was divided in two phases: 5 days for adaptation to the diet and to the cage and 3 days of balance period with total excreta collection. Birds were fed *ad libitum* and feed intake was measured individually. In addition, broilers were starved for 17h before weighing at the beginning and at the end of the collection period. Individual excreta were stored at -20°C, freeze-dried, then left 48h at ambient temperature to stabilise the moisture content before weighing, grinding (0.5mm) and analyses.

For each experiment, one group was affected to the basal diet. For others, experimental diets include the tested raw material (10 to 30 %). The amount of mineral, trace and vitamins were 3% for all diets, and 17 to 20 % of protein.

Apparent metabolizable energy (AME) of diets was calculated as the difference between GE intake and energy losses in excreta. AME values were then corrected for nitrogen retention (AMEn) using a factor of 34.4kJ/g. Protein utilization was calculated as the ratio between protein intake and protein excreted (with total nitrogen excreted corrected by nitrogen of ureic acid in excreta). Values of the raw materials were then calculated by difference between basal and experimental diets according to the dry matter content (Lessire & *al*, 1985).

Investigated raw materials were of different origins and supplied by producers:

i) Current protein sources ; ii) Unusual or new products ; iii) Animal products

[1] National Institute of Agricultural Research (INRA), UE EASM, Station du Magneraud - CS 40052
17700 Surgères France
[2] Research Institute of Organic Farming (ITAB), 9 rue André Brouard, 49105, Angers cedex 2
[3] Chambre d'Agriculture des Pays de la Loire (CRAPDL), 9 rue André Brouard, 49105, Angers cedex 2

Results

All results are presented in **table 1.**

Current protein sources

Soya bean and sunflower meals are the main organic protein sources used in poultry feeds in France, and tested samples were provided by different manufactories. It is well known that their fat content is higher than for conventional meals. For Soya, fat content is not as constant as expected, and correlatively AMEn and protein utilization varied in a large range, 2678 to 3123 Kcal / kg DM and 79.92 to 85.90 % respectively. For Sunflower meal, high variability was observed for all criteria, fat and protein as well as AMEn and protein utilization. When compared with values of conventional raw materials (based on INRA table, Sauvant, 2002), Soya, Sunflower and Organic Rapeseed meals presented a higher AMEn value and a lower apparent digestibility of protein than conventional meals. Nutritional values of organic extruded soya bean, alfalfa concentrate, pea and horsebean are quite similar to the values of the same conventional products. Pea and Horsebean presented a higher utilization of protein than Soya meal, but with lower protein content. Alfalfa concentrate presented a high protein content but with low digestibility.

Unusual or new products

Extruflax was a new product, with the objective to promote the use of linseeds in poultry nutrition. To be used in poultry, linseed must be heated to destroy antinutritional factors. Extruflax had a high fat content and a high AMEn value, but protein content and utilization were lower than Soya value. For Cannabis meal and dehulled seeds protein level is lower than Soya meal, 31.7, 32.3 and 45.3 % respectively. However digestibility is good and improved by dehulling. Camelina meal and Lupine seeds are not of current use in poultry, due to their fiber and ANF (antinutritional factors) content. In this study, feed containing Camelina was not well ingested by animals, so digestibility results were low or too variable. For Lupine digestibility results are good, but with a diet containing 20 % of Lupine and for a short period. One of the objectives of this study was to give a nutritional value to forages : grass may represent till 10 % of the dry matter ingested (Germain & *al*, 2013). Tested products were dried, of high quality (25 & 27 % of protein), and included to the diet at 10%. Energy value was low, mainly correlated to soluble sugars, but protein utilization was closed to Soya meal value.

Discussion

Regarding to the energy and protein utilization of a large range of organic raw materials:
- Organic Soya bean meal gave good results but with variability in fat content and protein utilization
- For other meals, Sunflower, Rapeseed, Cannabis, Camelina, protein content and digestibility were lower than Soya meal. Digestibility may be negatively affected by their ANF content.
- For all tested products, processing –extrusion, dehulling- improved digestibility of protein and energy.
- Seeds and beans presented good protein utilization. However their protein content is lower than Soya meal and their amino acid profile is not optimal for poultry.
- Forages, if they are of good quality, may represent a contribution to protein supply of broilers
- Sea products, like *Crepidula fornicata,* presented high protein content and nutritional value. However to be used in poultry feed, the product must be dried and there is a risk for fish taste in poultry meat.
- Larva of insect may represent an opportunity, but their digestibility is low and not constant.

Table 1 : Analytical and nutritional values of raw materials

	Dry matter (%)*	Ash (%)*	Protein (%)*	Fat (%)*	Gross Energy (Kcal/Kg)*	AMEn (Kcal /kg) *	Protein utilization (%) *
Soya bean meal	90,89 (90,35-91,69)	6,65 (6,50-6,85)	45,28 (44,93-45,49)	6,97 (4,66-9,06)	4998 (4909-5044)	2966 (2678-3122)	83,73 (79.92-85.90)
Extruded soya bean	90,60	6,00	41,45	12,24	5608	3856	86,50
Sunflower meal	91,94 (91,18-92,76)	5,60 (5,36-6,00)	24,36 (21,76-28,18)	16,47 (12,97-18,25)	5366 (5199-5455)	2374 (2275-2597)	79,27 (76.47-81.55)
Alfalfa protein concentrate	93,40	12,76	52,31	ND**	5244	3267	71,56
Rapeseed meal	88,84	7,24	31,78	12,79	5123	2722	75,69
Pea	87,40	3,30	22,87	0,89	4409	3272	87,01
Horsebean	87,70	3,60	31,04	1,05	4511	3247	83,30
Cannabis meal	90,35	6,91	31,68	14,13	5299	3135	81,88
Dehulled cannabis seed	92,50	6,93	32,33	49,92	7049	6453	86,70
White lupine bean	88,90	3,40	35,64	10,85	5279	3246	94,80
Camelina meal	90,50	6,60	34,55	15,95	5300	ND **	46,49
Extruflax	92,17	2,62	18,92	23,40	5692	4472	79,80
Fescue	94,10	11,40	25,06	2,51	4445	1364	82,10
Rye grass	93,80	13,40	27,53	3,14	4478	1282	79,90
Larva of insects	84,40	8,36 (7,57-9,15)	42,50 (37,76-47,23)	28,63 (22,22-35,03)	6407 (5786-7028)	4636 (4517-4755)	68,69 (62.68-74.70)
Sea product	91,35	22,04	51,85	2,85	3646	3837	100,00

(*) : values into brackets are the lowest and the highest
(**) : Non determinated

Animal products

For larva, the two tested products came from the same species, but differ on ash, protein and fat content, and consequently on digestibility values.

The sea product, *Crepidula fornicata*, is well known as a parasite for oysters and is available in large amount. This product presented a high level of protein and a very high digestibility. To be used in poultry feed, the product must be dried.

Suggestions to tackle with the future challenges of organic animal husbandry

The opportunity of using larva of insect in organic monogastric nutrition must be allowed by regulation.

There is a need for complementary studies about: i) amino acid profile of these raw materials; ii) the combination of these raw materials in the broiler diets and during the life of animals; with the objective to improve sustainability of organic production.

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