# Value of chickpea as animal feed

Cordesse R.

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R. CORDESSE
ECOLE NATIONALE SUPERIEURE AGRONOMIQUE
INSTITUT NATIONAL DE LA RECHERCE AGRONOMIQUE
CHAIRE DE ZOOTECHNIE,
34060 MONTPELLIER CEDEX, FRANCE

SUMMARY - The chemical composition of chickpea and dry pea grains is similar except for a higher fat content in the former. A low concentration of sulphure containing amino acids is a major nutritional limitation in chickpea. It also has high content of antitrypsic factors but it is possible to destroy these factors by a heat treatment. Chickpeas as well as dry peas may be used for animal feeding without restriction for ruminants, but for pigs and poultry limitation is necessary. However the mixing rate is not yet specified for the chickpea. It would be desirable to reduce the content of antinutritional factors by a genetic improvement of the cultivars.

*RESUME - "Valeur du pois chiche comme aliment pour le bétail". Les graines de pois chiche et de pois ont une composition chimique similaire excepté pour la teneur en huile qui est plus forte chez le premier. La principale limitation nutritionnelle du pois chiche est sa faible teneur en acides aminés soufrés. Il possède aussi une forte teneur en facteurs antitrypsiques, mais il est possible de les détruire par la chaleur. Pois chiche et pois peuvent être utilisés pour l'alimentation animale sans restriction en ce qui concerne les ruminants; mais pour les porcins et les volailles une limitation est nécessaire. Cependant le taux d'incorporation n'est pas encore établi pour le pois chiche. Il serait nécessaire de réduire la teneur en facteurs antinutritionnels par amélioration génétique des cultivars.*

## Introduction

Protein rich grains such as peas and faba beans are in considerable use in the industry producing feed for non ruminants and ruminants. Their antinutritional factor content being 30 to 40 times lesser than that of soyabean their untoasted cakes directly can be used under certain conditions. However, a toastage and extrusion improves the nutritive value of these grains as well (Melicon, 1986).

The chickpeas are grown in arid areas where they may have advantage over other protein rich grains. Could they play a role in animal nutrition in those areas?.

Pichinoni (1965), in his work "Dictionnaire des aliments pour les animaux" reserves an important place for chickpea and underlines its importance for protein supply in Mediterranean regions. Chickpea is richer in fat than other leguminous grains. It also contains assimilable calcium and phosphorus, so it is suitable for diet improvement. Its nutritive value can be raised by cooking.

When fed chickpeas, horses develop a bright coat and a soft skin, a sign of good health. In British India, chickpea was used as a ration for horses of military cavalry. In late 50's, when soybean cake had yet to spread in Europe, the chickpea was used in the finishing ration for pigs in Spain and for lambs in France. The carcasses of these animals were curled due to the presence of a white tough fat.

Due to insufficient production of chickpea in many countries, its use is now mainly restricted for human food after cooking. In Mexico, however, 70% of chickpea production is used for animals.

Table 1 presents the chemical composition of several feeds. Data for soyabean, faba bean and dry pea are from INRA Tables 1987. Data on chickpea are from analysis carried out by an INRA Laboratory in Bordeaux, on samples from ENSA, Montpellier and also from different publications (Van der Maesen, 1972; Ben Ali, 1980; Melcion,1986). The characteristics of "soyabean cake 48" are reported because it constitutes main protein supply in the "control" ration of many experiments.

For the three protein sources presented, the different chemical elements are considerably similar. The fat content of chickpea is high (4.5 to 10%), and this may contribute to a higher concentration of gross and available energy in chickpea than in other grains. In all cases the

**Table 1. Centesimal composition and gross energy of soyabean cake and some protein rich grains.**

| | OM | Ash | CP | PS | NFE | Fat | NDF | Lignin | Gross energy |
|---|---|---|---|---|---|---|---|---|---|
| Soyabean cake | 92.9 | 7.1 | 52.0 | 30 | 32.1 | 2.3 | 14.0 | 2 | 4750 |
| Soyabean grains | 95.0 | 5.0 | 41.7 | – | 25.0 | 20.2 | 13.5 | 2 | 5600 |
| Faba bean | 94.1 | 3.9 | 30.3 | 70 | 55.7 | 1.5 | 12.6 | 1 | 4480 |
| Dry pea | 94.1 | 3.9 | 25.0 | 78 | 61.3 | 1.8 | 14.0 | 1 | 4420 |
| Chickpea[a] | 96.6 | 3.4 | 23.6 | 62 | – | 4.9 | 16.6 | 1 | 4650 |

OM : Organic matter; CP : Crude protein; PS : Protein solubility (%); MFE : Nitrogen free extract; NDF : Neutral detergent fiber; [a]/ ENSA Montpellier collection.

**Table 2. Effect of extrusion on antinutritional factors in some protein rich grains (Melcion, 1986).**

| Antinutrional factors | Pea | | Chickpea | | Faba beans | | Lentil | |
|---|---|---|---|---|---|---|---|---|
| | C | E | C | E | C | E | C | E |
| Antitrypsic activity (TIU/mg) | 9.6 | 0.23 | 13.8 | 0.62 | 22.0 | 0.55 | 3.4 | 0.48 |
| Hemaglutinic activity (HIU/mg) | 200-400 | 0-0.6 | 800-1600 | 0.8-1.6 | 3200-6400 | 6-12 | 400-800 | 3.2 |

TIU : Trypsic inhibition unit;
HIU : Hemagglutinant inhibition unit;
C : Control; E : Extruded.

lignin content is very low, which suggests a good organic matter digestibility.

Protein rich grains contain less antinutritional factors, however, many researchers have tested the eficiency of a heat treatment similar to the one used with soyabean cake. Melcion (1986) measured change in the control of antinutritional factors in some protein rich grains, with a cooking-extrusion treatment. These results are reported in Table 2.

After heat treatment, the proteinaceous antinutritional factors are only found in traces. On the other hand, the galactosides responsible for flatulence are not reduced and they could constitute a limiting factor for feeding non-ruminants. However, heat treatments also affect the biological value of proteins. Ben Ali (1980) studied the availability of amino acids in chickpea, as affected by heat treatment (Table 3).

These results show that the deficiency in sulphur amino-acids of chickpea protein is increased by heat treatments. Rossi *et al.* (1984) confirmed the primary deficiency of sulphur amino-acids.

**Table 3. Chemical index of essential and semi-essential amino-acids of the chickpea protein (ben ali, 1980).**

| Amino-acids | Ideal protein FAO/WHO (1973) | Untreated chickpea | | Autoclaved chickpea | | | |
|---|---|---|---|---|---|---|---|
| | | | | 110ºC/15' | | 140ºC/13' | |
| | d | a | b | a | b | a | b |
| Isoleucin | 4 | 4.5 | >100 | 4.0 | 100 | 4.4 | >100 |
| Leucin | 7.04 | 7.5 | >100 | 7.1 | >100 | 8 | >100 |
| Lysin | 5.44 | 7.1 | >100 | 6.0 | >100 | 4.2 | 77.2 |
| Sulphure amino-acids | 3.57 | 2.5 | 71.0 | 2.2 | 62.5 | 1.8 | 51.1 |
| Phenylalanin + trypsin | 6.08 | 8.7 | >100 | 7.6 | >100 | 5.7 | 93.7 |
| Theonin | 4 | 3.5 | 87.5 | 2.9 | 72.5 | 2.7 | 67.5 |
| Tryptophan | 0.96 | 0.9 | 93.7 | 0.9 | 93.7 | 0.8 | 83.3 |
| Valin | 4.96 | 4.2 | 84.7 | 5.0 | >100 | 5.0 | >100 |
| Total | 36 | 38.9 | | 35.7 | | 32.6 | |
| 1st limting amino-acids | | Sulphur amino-acids | | Sulphur amino-acids | | Sulphur amino-acids | |
| 2nd and 3rd limiting amino-acid | | Valin + Threonin | | Threonin + Triptophan | | Threonin + Lysin | |

a = n g/16 g N; b = a/d x 100.

## Biological test for anti-nutritional factors

Many tests (Leclerq and de Past, 1965; Davis and Sosulski, 1973; Pracros, 1982) have shown that the flour worm (*Tenebrio molitor*) has the same requirements in essential amino-acids, minerals and vitamins, as higher animals, and it is very sensitive to the presence of antinutritional factors; so this has been proposed to be used for biological tests.

Paracros (1987) applied this test to seven chickpea varieties. She showed that there was no difference among varieties, and that feed conversion was improved with increasing levels of chickpea meal in the diet. The author concluded that chickpea was a good nitrogen source for the larvae of *Tenebrio molitor* and this must be tested on higher animals.

## Use of chickpea by higher animals

### Utilization by non-ruminants

The rat is generally not used as a test animal but it is a good model for non-ruminants. Ben Ali (1988) carried out a study using four groups of 8 rats maintained in individual cages and receiving isonitrogen diets (10 to 15% protein) where only the source of protein was changed. One group of rats was fed on diets made of untreated chickpea, the other groups on the one made of chickpea treated by autoclaving at a temperature of 110 °C for 15 mn or 140 °C for 30 mn. The control group was fed on a casein based diet. Results obtained with the 10% level of protein (Table 4) show that a proper heat treatment of chickpea gives zootechnical performance similar to that obtained with a high quality protein such as casein, the biological value being only slightly lower. An improper heat treatment leads to poor performance. Compared to the control group, untreated chickpea shows slightly lower performance. Daily growth is reduced by 12% despite the high quantity consumed (+2%).

These results are in conformity with those of Akbar *et al.* (1986) on rats. and Visitpanich *et al.* (1985) on rats and pigs.

The level of untreated chickpea needed for good performance is not known as yet. Studies conducted using untreated spring dry pea show the performance of pigs and poultry on this diet to be similar to that obtained with the control, if the level of incorporation of pea in the ration was 16% for gestating sows and 24% for lactating ones (Gatel *et al.*, 1987), 30% for pigs for pork-butcher meat (Grosjean *et al.*, 1986), growing chicken (Lacassagne, 1988) and layers (Guillaume, 1977; Lacassagne, 1988).

Pigs raised on a diet incorporating 30% winter peas, which are four times richer in antitrypsic factor than chickpea, showed decreased performance than those raised on standard diet (Grosjean *et al.*, 1986). With the above levels of incorporation, the decrease in performance comes from a lower energy concentration. In fact in a broiler ration, an addition of 44 g of oil and 2,5 g of methionine per kg of feed allowed the incorporation of 66% of raw pea while the growth performance of chicken was maintained (Garambois and Goussopoulos, 1982).

These results permit us to speculate that chickpeas which are richer in fat than dry peas, could be incorporated at a higher level in non ruminant feed.

**Table 4. Effect of chickpea autoclaving on zootechinical characteristics of rates and the biological value of protein.**

| Protein source | DWG index (100 for control group) | Intake (100 for the control group) | Feed efficiency | Protein efficiency coefficient | Protein digestibility % | Biological value |
|---|---|---|---|---|---|---|
| Casein | 100 | 100 | 4.4 | 2.3 | 89.8 | 79.7 |
| Untreated chickpea | 88 | 102 | 5.1 | 2.0 | 82.8 | 72.3 |
| Chickpea treated 110°C for 15' | 104 | 102 | 4.3 | 2.3 | 86.2 | 76.1 |
| Chickpea treated 140°C for 30' | 8 | 55 | NS | 0.4 | 78.1 | 56.2 |

### Utilization by ruminants

Peas and faba bean have been used in many feed experiments for sheep, goats and cattle (Cazes, 1978) and results have shown that it is possible to totally replace protein rich cakes by dry peas. Experiments using chickpea are, however, rare.

Two varieties of chickpea differing in their protein concentration (22.5 and 26,2%) were compared in a growth test using 30 day old rabbits (Lebas, 1988)). Chickpeas were incorporated at levels of 10 to 20% in the feed to substitute soyabean cake and wheat meal according to the following relationship: 10 parts of chickpea (22.5% protein content) = 6.8 parts of wheat + 3.2 parts of soyabean cake; 10 parts of chickpea (26.2% protein content) = 5.7 parts of wheat + 4.3 parts of soyabean cake. A group feeding on standard diet without chickpea was used as control. No differences were noticed in terms of quantity of feed consumed, organic matter digestibility and zootechnical performances. Digestible energy concentration of chickpea incorporated diet varied from 3100 to 3200 kcl/kg and was thus intermediate between the diet containing soyabean cake and wheat meal. The nitrogen digestibility was 70% for variety with a high protein concentration, and 82% for the one with a low protein concentration.

Two other experiments were conducted on lambs as a part of the same study. In both experiments, soyabean cake was totally substituted by the chickpea grains. In the first one (Cordesse *et al.*, unpublished) the effect of grain crushing (crushed and uncrushed grains) was tested using dark seeded chickpea variety INRA 199. In the second experiment (Demarquet *et al.*, unpublished) uncrushed grains from two varieties INRA 199 and a kabuli chickpea, were compared.

The crude protein content of the diet was 16% in the first experiment and 17% in the second. The animals used in the study were 60 to 100 days old males of Merinus d'Arles x Ile-France breed in first experiment and 75 to 120 days old males of Pre'alpes breed in the second experiment.

The main results are presented in Table 5.

From the first experiment, it can be seen taht there was no effect of the incorporation of chickpea in the diet and crushing did not make any difference. The results have to be, however, viewed with reservation because only 15 lambs out of 30 were provided with chickpea up to the slaughtering because of shortage of chickpea. The other animals were on commercial feed for 8 days before slaughter.

In the second experiment, final liveweight and daily weight gain show significant differences between the control group and the groups fed the chickpea diet. The chickpea variety differences were not significant. Carcass yield was similar in the 3 groups. The feed conversion value (4.89) in the control group was better than in the two chickpea groups (5.18 and 5.33 for kabuli and INRA 199 chickpea, respectively).

Experiments are being repeated to confirm results.

**Table 5. Effect of chickpea incorporation in the diet on the perfomance of lambs in two feeding experiments.**

| Zootechnical perforance crude | Experiment No.1 Diet treatment | | | Experiment No.2 Diet treatment | | |
|---|---|---|---|---|---|---|
| | Control (commercial feed) | Crushed INRA 199 | Uncrushed INRA 199 | Control SMB cake | Kabuli chickpea | INRA 199 |
| Liveweight (kg) | | | | | | |
| - inicial after adaptation | 17.2 | 16.0 | 16.7 | $26.5^{A}$ | $25.4^{B}$ | $25.6^{B}$ |
| - final | 30.1 ±0.37 | 28.0 ±0.27 | 28.4 ±0.46 | $38.9^{A}$ | $35.5^{B}$ | $35.4^{B}$ |
| Daily wieght gain (g) | 322 ±49 | 300 ±40 | 294 ±54 | $293^{A}$ | $320^{B}$ | $231^{B}$ |
| Feed efficiency concentrats | 3.58 ±1.14 | 3.58 ±1.69 | 3.57 ±1.09 | 4.89 | 5.18 | 5.83 |
| Carcass yield (%) | 51.1 | 52.3 | 50.2 | 48.5 | 48.9 | 49.1 |

## Conclusion

The presence of antinutritional factors in chickpea does not appear to be a limiting factor for its utilization by ruminants. For non-ruminant feeding it is desirable to reduce the level of antinutritional factors and the fiber content.

A relatively higher fat content (4 to 10%) gives chickpeas a superiority as energy source over other protein rich grains. In addition as the deficiency in sulphur amino-acids can be easly and economically corrected by the use of methionine, chickpea can become a promising feed for non-ruminants.

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