# Effect of different processing methods on the nutritional characteristics and tannin content of fababean seed (*Vicia faba minor*)

Guido Ferruzzi, Alessandro Pistoia, Gino Balestri, Laura Casarosa, Piera Poli

Dipartimento di Agronomia e Gestione dell'Agroecosistema,Università di Pisa, Italy

*Corresponding author*: Guido Ferruzzi. Dipartimento di Agronomia e Gestione dell'Agroecosistema. Università di Pisa. Via S. Michele degli Scalzi 2, 56124 Pisa, Italy - Tel. +39 050 2218921 – Fax: +39 050 2218970 - Email: gferruz@agr.unipi.it

**ABSTRACT** - In the last years, because of their high protein content, the demand of legume seeds is significantly increased. In the centre and southern Italy fababean (*Vicia faba minor*) can play an important role as alternative protein source in ruminant nutrition. In this trial has been studied the effect of different treatments (flaking, cooking, dehulling, germination) on the *in vitro* digestibility and tannin content of fababean seeds. The *in vitro* OM and NDF digestibility of seeds were significantly ($P<0.05$) improved by dehulling and flaking. The *in vitro* OM digestibility of dehulled fababean (99.27%) showed higher values ($P<0.05$) than the other treated seeds as well as *in vitro* NDF digestibility (90.33%, $P<0.05$). Germination of fababean reduces the *in vitro* digestibility of OM and NDF. Cooking in water was more effective in reducing tannins than other treatments. Compared to the untreated the cooked has significantly ($P<0.05$) reduced the tannin content over 55% (2.71 g/kgDM vs. 6.10 g/kgDM). Germinated fababean did not affect the tannin content of seeds. The results from this trial suggest that thermal treatments applied to fababean seeds in order to reduce the tannins must be evaluated according to the cost/benefits ratio because this factors in seeds is low (<10 g/kgDM).

*Key words*: Fababean, Treatments, Tannins, *In vitro* digestibility.

**Introduction** - Recently the increasing demand for alternative protein sources in order to replace soybean meal in ruminant nutrition and the ban of GMO in organic farming (Reg.CE1804/99), renews the interest in legume seeds. In central and southern Italy was widely rediscovered fababean (*Vicia faba minor*) one of the oldest crops cultivated by human since Neolithic. This crop is appreciated especially for the agronomic advantage as N-fixing and the high crude protein content of seeds. Currently soybean meal is the main protein source in ruminant and monogastric nutrition but its replace with others grain legumes shows some problems, which are caused by high costs compared to soybean meal, the presence of antinutritional factors (tannins) and the low protein content compared to soybean meal. The crude protein content of fababean can reach over 30% of dry matter basis with a good composition in essential amino acids (Dixon and Hosking, 1992; Gatel, 1994, Duc, 1997). The presence of antinutritional factors in seeds is an important aspect. These antinutritional factors are especially located in the hulls of the seeds (Newton and Hill, 1983) and in fababean are represented mainly by polyphenolic compounds such as tannins. The tannins, however, can easily be reduced by heat treatment, cooking in water, or with dehulling (Khalil and Mansour, 1995; Alonso *et al.*, 2000). This trial was carried out in order to evaluate the effects of different treatments on the OM and NDF in vitro digestibility and to determine the effect of these treatments on the tannin content of fababean seeds.

**Material and methods** - Samples of fababean grains (Vesuvio var.) were collected from a seed lot bought from the company SIS (Società Italiana Sementi). A representative sample of seeds were

treated as follows: flaking, performed at a local feed industry (F), cooking in water at 100°C for 30' (C), germination (G) (Khalil and Mansour, 1995) and dehulling (D) performed manually in order to remove the hulls of seeds. Samples treated and untreated (UT) were ground and then analysed for dry matter (DM), ash, crude protein (CP), ether extract (EE), (AOAC, 1995); neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) using the Ankom Fiber Analyzer (Ankom 220, Ankom Technology, Fayrport, NY). No-structural carbohydrates (starches and sugars) were calculated using the formula: 100-PG-EE-ash-(NDF-NDFIP), where NDFIP are the neutral detergent fiber insoluble protein (NRC, 2001).The nutritional value of each sample was estimated according to INRA (1988) and expressed as Milk Forage Unit (Milk FU/kg DM). The tannin content was determined by the Folin-Ciocalteau method (Makkar *et al.*, 1993) using tannic acid solution as standard. *In vitro* organic matter digestibility (IVOMD) and *in vitro* neutral detergent fiber digestibility (IVNDFD) were determined with the Daisy incubator (Daisy II 220, Ankom Technology, Fayrport, NY) as described by the Ankom procedures (2006). Data were processed by JMP-SAS software (2007) using the linear model: $Y_{ik}=\mu+\alpha_i+\varepsilon_{ik}$: were: $Y_{ik}$=single observation; $\mu$=overall mean; $\alpha_i$=effect of treatments (i=1, 2, 3, 4); $\varepsilon_{i\,k}$=experimental error.

Table 1. Chemical composition of fababean seeds in relation to the different processing methods (% Dry Matter).

| | | *Vicia faba minor*: treatment | | | | |
|---|---|---|---|---|---|---|
| | | UT | D | F | C | G |
| DM | % | 93.54 | 92.33 | 90,64 | 92,14 | 92.5 |
| CP | %DM | 29.5 | 33.77 | 29.65 | 29.00 | 30.17 |
| EE | " | 1.26 | 1.22 | 1.29 | 1.28 | 1.93 |
| Ash | " | 3.91 | 4.11 | 4.07 | 3.71 | 3.89 |
| NSC | " | 42.01 | 50.01 | 44.94 | 43.12 | 49.01 |
| NDF | " | 24.52 | 12.27 | 21.26 | 24.07 | 24.23 |
| NDFIP | " | 1.20 | 1.38 | 1.21 | 1.18 | 1.23 |
| ADF | " | 13.47 | 2.35 | 12.94 | 17.35 | 11.22 |
| ADL | " | 1.91 | 0.72 | 1.77 | 1.59 | 1.99 |
| Nutritive value | Milk FU/kg DM | 1.01 | 1.19 | 1.15 | 1.08 | 1.12 |

*UT: untreated; D: dehulled; F: flaked; C: cooked; G: germinated.*

Table 2. Tannin content of fababean seeds in relation to the different processing methods.

| | | *Vicia faba minor*: treatment | | | | | |
|---|---|---|---|---|---|---|---|
| | | UT | D | F | C | G | SE |
| Tannin | g/kg DM | 6.10$^a$ | 4.69$^c$ | 4.92$^b$ | 2.71$^d$ | 5.93$^a$ | 0.19 |

*$^{a,b,c}$P<0.05. UT: untreated; D: dehulled; F: flaked; C: cooked; G: germinated.*

Table 3. In vitro digestibility (%) of organic matter and neutral detergent fiber of processed seeds.

| | *Vicia faba minor*: treatment | | | | | |
|---|---|---|---|---|---|---|
| | UT | D | F | C | G | SE |
| IVOMD | 91.38$^c$ | 99.27$^a$ | 92.46$^b$ | 89.46$^d$ | 90.39$^{cd}$ | 0.36 |
| IVNDFD | 51.81$^c$ | 90.33$^a$ | 55.41$^b$ | 48.71$^c$ | 39.06$^d$ | 1.37 |

*$^{a,b,c}$P<0.05. UT: untreated; D: dehulled; F: flaked; C: cooked; G: germinated.*

**Results and conclusions** - Table 1 shows the average chemical composition and the feed value of treated fababean seeds, the values of untreated seeds (UT) agree with data reported in other works (Dixon and Hosking, 1992). Compared to the control (Table 2) the cooking reduces significantly (P<0.05) tannins (about 55%) and similar results were obtained by Van der Poel *et al.*, (1991). Flaking (F) reduces significantly (P<0.05) tannins, but less than cooking (C). Compared to the untreated (UT) flaking reduces of about 20% tannins in seeds. No sig-

nificant differences (P>0.05) were observed in germination. Similar results were reported by Khalil and Mansour (1995) that observed a less effective action of germination than heath treatments in reducing tannins. Unlike our results, with the germination, Kyarisiima *et al.* (2005) has reduced tannins in sorghum. Removal of seed hulls (D) significantly (P<0.05) reduces tannins of about 23% in comparison to UT. IVOMD of UT seeds (Table 3) is similar to Abreu and Bruno-Soares (1998), dehulled seeds (D) show the highest (P<0.05) IVOMD, followed by F and UT, while our results highlighted no differences between C and G which show the lowest digestibility, the same results were obtained in dehulled seeds for IVNDFD. In comparison to the UT, dehulled seeds show the highest digestibility of NDF fraction, with a difference of about 38%. More remarkable differences (51%) were observed between the D and the G, while no significant differences (P>0.05) were found between the C and UT. Finally, flaking is also an effective treatment to improve IVNDFD. We can conclude that the treatments D and F improve the *in vitro* digestibility of seeds and reduce the tannins content, while treatment C reduces tannins but don't improve the digestibility. The G treatment does not seem to bring a significant improvement in tannin content and IVOMD. Negative results were observed in IVNDFD of G, with a reduction of about 13% in comparison to UT. The results of this trial suggest that processed fababean seeds (dehulled and flaked) improve their nutritional characteristics and can represent an alternative to other protein sources like soybean meal, particularly in organic farming, where the use of alternative legume grains is supported by the EU Regulation (Vasta *et al.*, 2008). However some treatments applied in this trial don't yield positive results, especially germination. The application of heat treatments to reduce tannins in fababean seeds must be evaluated according to the cost/benefit analysis because these antinutritional factors in seeds are very low (<10g/kgDM).

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