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ORIGINAL ARTICLE

# Dietary inclusion of raw faba bean instead of soybean meal and enzyme supplementation in laying hens: Effect on performance and egg quality

**M.E. Abd El-Hack [a], M. Alagawany [a], V. Laudadio [b], R. Demauro [b], V. Tufarelli [b,*]**

[a] *Poultry Department, Faculty of Agriculture, Zagazig University, Zagazig 44511, Egypt*
[b] *Department of Emergency and Organ Transplantation (DETO), Section of Veterinary Science and Animal Production, University of Bari 'Aldo Moro', Valenzano 70010, Bari, Italy*

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**Abstract** An experiment was conducted with 160 Hisex Brown laying hens to evaluate the effect of different inclusion levels of faba bean (FB) and enzyme supplementation on productive performance and egg quality parameters. The experimental diets consisted of five levels of FB: 0% (control), 25%, 50%, 75% and 100%, substituting soybean meal (SBM), and two levels of enzyme supplementation (0 or 250 mg/kg). Each dietary treatment was assigned to four replicate groups and the experiment lasted 22 weeks. A positive relationship ($P < 0.05$) was found between FB inclusion and body weight (BW) change of hens when compared to those of the control treatment. Enzyme supplementation significantly affected the final hens' BW. Feed consumption (FC) of hens was statistically increased with increasing FB level up to 50%. Supplementing dietary enzyme mixture at 250 mg/kg led to improvement in FC at all studied ages ($P < 0.05$). Inclusion of 25% or 50% FB in diets had no adverse effects on feed conversion ratio (FCR) compared to the higher FB inclusion levels (75% or 100%). Egg weight (EW), egg number (EN) and egg mass (EM) were significantly ($P < 0.05$) influenced by FB inclusion in diet during the entire experimental periods, except for EN and EM at 20–24 weeks of age. Egg productive parameters were not influenced by enzyme mixture supplementation ($P > 0.05$). The main effect of FB levels replacing for SBM affected ($P < 0.05$) yolk and shell percentages, yolk index, yolk to albumen ratio, shell thickness and egg shape index. It can be concluded that FB and enzyme supplementation could be included

* Corresponding author at: Department of Emergency and Organ Transplantation (DETO), Section of Veterinary Science and Animal Production, University of Bari 'Aldo Moro', Strada Prov. le per Casamassima, km 3, Valenzano 70010, Bari, Italy.
E-mail address: vincenzo.tufarelli@uniba.it (V. Tufarelli).
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in hens diet at less than 50% instead of SBM to support egg productive performance, however higher raw FB levels negatively affected egg production indices and quality.



## 1. Introduction

It is well known that prices of corn and soybean, which are mainly used in poultry diet, hit an all-time record high. Thus, there is an urgent need for affordable and nutritious feeds. Soybean meal (SBM) is the most commonly used protein source in poultry feeding and it is usually known for its high quality. Because SBM is the major by-product of oil extraction from soybean, costs and availability of SBM are strongly correlated with the price of agricultural commodities on the world market (Vicente et al., 2009; Jezierny et al., 2010). World market prices are influenced by variations in economic growth and changes in consumer product preferences and on weather conditions (Trostle, 2008; Jezierny et al., 2010; Cazzato et al., 2014). Therefore, price and availability SBM on global markets may change rapidly, thereby stimulating interest in maximizing the use of locally produced feed ingredients including grain legumes (Ravindran and Blair, 1992; Laudadio and Tufarelli, 2011).

Fava beans (*Vicia faba* L.) are widely produced in several countries, such as the Mediterranean area, and because of their good nutritional value, they can be used as an alternative protein source in place of soybean meal (Castanon and Perez-Lanza, 1990; Nalle et al., 2010). However, the presence

**Table 1** Ingredients and experimental diets of laying hens.

| | Dietary treatments | | | | |
|---|---|---|---|---|---|
| | 0 | 25 | 50 | 75 | 100 |
| Ingredients, % | | | | | |
| Corn | 60.58 | 59.76 | 58.81 | 58.24 | 57.00 |
| Soybean meal (44%) | 22.00 | 16.50 | 11.00 | 5.50 | 0.00 |
| Faba beans (30%)[1] | 00.00 | 5.50 | 11.00 | 16.50 | 22.00 |
| Gluten meal (62%) | 5.01 | 6.20 | 7.40 | 8.73 | 10.07 |
| Limestone | 8.17 | 8.20 | 8.30 | 8.32 | 8.35 |
| Di-calcium | 1.82 | 1.82 | 1.75 | 1.70 | 1.63 |
| Layer premix[2] | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| L-Lysine HCL | 0.01 | 0.08 | 0.11 | 0.15 | 0.18 |
| Dl-methionine | 0.09 | 0.14 | 0.15 | 0.16 | 0.17 |
| Vegetable oil | 1.72 | 1.20 | 0.78 | 0.10 | 0.00 |
| Nutrient composition, %[3] | | | | | |
| Crude protein | 18.00 | 18.01 | 18.00 | 18.00 | 18.00 |
| ME, kcal/kg | 2851 | 2851 | 2854 | 2849 | 2872 |
| Ca | 3.63 | 3.64 | 3.65 | 3.63 | 3.61 |
| Non-phytate P | 0.46 | 0.45 | 0.45 | 0.45 | 0.45 |
| Lysine | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Met + Cys | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Crude fiber | 3.08 | 3.06 | 3.19 | 3.31 | 3.43 |
| Threonine | 0.65 | 0.76 | 0.88 | 0.99 | 1.10 |
| Linoleic acid | 2.28 | 1.40 | 1.38 | 1.36 | 1.34 |
| Ether extract | 2.60 | 2.70 | 2.80 | 2.92 | 3.01 |
| Nutrient composition, %[4] | | | | | |
| DM | 89.16 | 89.00 | 88.79 | 88.70 | 88.68 |
| OM | 79.52 | 95.10 | 95.54 | 95.05 | 95.41 |
| CP | 17.97 | 18.08 | 17.71 | 17.78 | 18.01 |
| EE | 2.25 | 4.54 | 4.40 | 3.84 | 3.96 |
| CF | 2.79 | 3.12 | 3.09 | 2.96 | 2.90 |
| Ash | 2.48 | 4.90 | 4.46 | 4.45 | 4.59 |
| Cost per ton[5] | 2793 | 2803 | 2802 | 2781 | 2807 |

[1] Chemical composition of faba bean (%): dry matter 87; crude protein 30; crude fat 2.7; crude fiber 9.3; ash 3.70; Ca 0.10; P 0.46.
[2] Contained per kg: vit. A, 8000 IU; vit. $D_3$, 1300 ICU, vit. E 5 mg; vit. K, 2 mg; vit. B1, 0.7 mg; vit. B2, 3 mg; vit. B6, 1.5 mg, vit. B12, 7 mg; Biotin 0.1 mg; Pantothenic acid, 6 g; Niacin, 20 g; Folic acid, 1 mg; Manganese, 60 mg; Zinc, 50 mg; Copper, 6 mg; Iodine, 1 mg; Selenium, 0.5 mg; Cobalt, 1 mg.
[3] Calculated according to NRC (1994).
[4] Chemical analysis according to AOAC (2006).
[5] Calculated according to the price of feed ingredients when the experiment was started.

**Table 2** Live body weight and body weight change of laying hens as affected by faba bean levels and enzyme supplementation during the experimental periods.

| Items | | Body weight (g) | | |
|---|---|---|---|---|
| | | Initial | Final | Change |
| *FB*[1] *(%)* | | | | |
| | 0 | 1662 | $1864^{b}$ | $201^{c}$ |
| | 25 | 1668 | $1992^{ab}$ | $323^{ab}$ |
| | 50 | 1670 | $1978^{ab}$ | $306^{b}$ |
| | 75 | 1672 | $2031^{ab}$ | $361^{ab}$ |
| | 100 | 1668 | $2080^{a}$ | $412^{a}$ |
| *Enzyme (mg/kg diet)* | | | | |
| | 0 | 1667 | $1967^{b}$ | $300^{b}$ |
| | 250 | 1670 | $2012^{a}$ | $342^{a}$ |
| *FB*[1] *× enzyme* | | | | |
| 0 | 0 | 1661 | 1843 | $181^{c}$ |
| | 250 | 1662 | 1884 | $222^{c}$ |
| 25 | 0 | 1668 | 1912 | $244^{c}$ |
| | 250 | 1669 | 2073 | $403^{a}$ |
| 50 | 0 | 1668 | 2024 | $355^{b}$ |
| | 250 | 1672 | 2038 | $366^{b}$ |
| 75 | 0 | 1668 | 1997 | $329^{bc}$ |
| | 250 | 1675 | 1959 | $283^{c}$ |
| 100 | 0 | 1667 | 2057 | $389^{b}$ |
| | 250 | 1670 | 2104 | $434^{a}$ |
| SEM [2] | | 1.99 | 70.05 | 69.37 |
| Two-way ANOVA | | *P*-value[3] | | |
| FB[1] | | 0.051 | < 0.001 | 0.041 |
| Enzyme | | 0.148 | 0.028 | 0.048 |
| FB[1] × enzyme | | 0.572 | 0.504 | 0.043 |

Means in the same column within each classification bearing different letters are significantly different ($P < 0.05$).
[1] FB: faba bean.
[2] SEM: standard error of the means.
[3] Overall treatment *P*-value.