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Temperature Treatment of Full-Fat Soybean on Starch Gelatinization and Egg Production

[1]R. Yañez Fabian, [2]J.R. Orozco Hernández and [2]I.J. Ruíz García
[1]Procesadora de Alimentos Integrales S.A. de C.V., San Juan de Los Lagos, Jalisco, Mexico
[2]Departamento de Ciencias Biológicas, Centro Universitario de Los Altos, Universidad de Guadalajara, Tepatitlán de Morelos, Jalisco, México

Abstract: Thermal treatment of oleaginous seed reduces anti-nutritional factors, but alters fatty acid stability and gelatinises starch, which in turn affects digestibility and poultry production. In the present study 90 Hy-Line W36 laying hens with 29 weeks of age (blocked by 15 animals (5 hens/nest)) were assigned randomly to six soy-bean temperature treatments; 84, 98, 110, 120 and 132°C (treatment 1, 2, 3, 4 and 5 for the extruder) and 124°C for the expander. The measured response was the hen production. The gelatinization percentage is dependant on the temperature and extruder pressure, but production parameters were not affected by thermal soybean treatment ($p>0.05$). In conclusion thermal soybean treatment can be used indistinctively since it dose not affect significantly the productivity of the laying hen.

Key words: Starch gelatinization, soybean, laying hen, production parameters, productivity

INTRODUCTION

Legume seed products form an important part of feed for animal (Arand *et al*., 2001; Fisher *et al*., 2001; Grandfeldt, 1993). The soybean meal obtained after oil extraction is normally used as a source of protein, amino acid, essential fatty acids and starch in poultry and pig production (Arand *et al*., 2001; Marsam *et al*., 1997; Perrilla *et al*., 1997; Sakomura *et al*., 1998). Starch is the primary glucose energy source in animal feeds, but legume starch (10-12% dry matter basis in soybean) generally is a less available energy source, specially in monogastric animals, than do cereals or grains because of its high amylose (19-22% in soybean) content (Arand *et al*., 2001; Douglas *et al*., 1999; Fisher *et al*., 2001; Friedman *et al*., 1991). Furthermore, amylopectin in the soybean branch chain-length is very short compared with other starches, it has low temperature for gelatinization (Arand *et al*., 2001; Turhan and Gunasekaran, 2002). Hence, the starch contained in the ingredients has a different effect on glucose-insulin blood level in the monogastric, which is related to the carbohydrate structure and absorption capacity (Grandfeldt *et al*., 1993; Turhan and Gunasekaran, 2002; Wang *et al*., 1998).

On the other hand, the untreated soybean contains various anti-nutritional factors that negatively affect the digestive function, but these factors can be reduced by thermal treatment but causes starch gelatinization which affects the nutrient availability for the monogastric (Friedman *et al*., 1991; Marsam *et al*., 1997; Perrilla *et al*., 1997; Sakomura *et al*., 1998). Furthermore, heat untreated starch has a slower rate of digestion, compared to the gelatinised one, limiting this way the enzyme access to nutrients (Jovanovich *et al*., 2003). Lampe *et al*. (2006) processing corn grain and Thurhan and Gunasekaran (2002) processing wheat, increased the degree of starch gelatinization, but reported a slight improvement in the broiler production. However, little published information was found on the thermal treatment of soybean, on the seed starch gelatinization and hen productivity.

MATERIALS AND METHODS

Twenty nine week old laying hens (Hy Line W36) were distributed randomly to six treatments. Each treatment had 15 hens (3 replicates of 5 hens) housed in cages of 59×60×40 cm. The extruder processing temperatures of the soybean seed were; 84, 98, 110, 120, 124 and 132°C. The starch gelatinization was assessed on the full fat soybean by colorimetry and the ingredients resulting of the thermal treatment of the soybean were used in a booster ration for the laying hens. The feed intake, egg number, egg weight and shell resistance were measured in a switch-back trial. The data obtained were subjected to variance analysis using the package of SAS (1985), stablishing an alpha of 0.05 to declare statistical differences among soybean seed thermal treatments.

Corresponding Author: R. Yañez, Procesadora de Alimentos Integrales S.A. de C.V., San Juan de Los Lagos, Jalisco, Mexico

RESULTS AND DISCUSSION

The full fat soybean meal nutritional value was similar among the thermal treatments ($p<0.05$), however, the temperature used had a direct effect on the gelatinization of starch contained in the seed (Table 1; $p<0.05$), which is in accordance with thurhan and Gunasekaran (2002) who using starchy grain reported higher content of modified starch. On the other hand, by increasing the seed treatment temperature the urease activity was reduced ($p<0.05$; Table 1), such observation was reported similar to the reported by Perrilla *et al.* (1997) when the soybean seed was treated thermally. Furthermore, the energy content of the food was lowered as the urease was reduced ($p<0.05$).

On the other hand, no relationship was observed between the digestibility and soybean processing temperature ($p>0.05$), which is contrary to the expected formation of the Maillard complexes that may affect the amino acid availability (Marsam *et al.*, 1997).

Heat reduces lectins content in the untreated soybeans and affects positively the amylase activity, increasing the starch digestibility according to reported by Barbi (1996) and Friedman *et al.* (1991). However, intake was not related to urease activity, suggesting that the anti-nutritional factors and processing temperature were not associated in the laying hen ($p>0.05$).

Egg mass was related soybean temperature treatment, indicating that feed to egg ratio was reduced ($p<0.05$; Table 2). Eventhough no clear relationship was observed between soybean processing and the feed intake ($p>0.05$). Animals tended to increase the consumption as the temperature of the soybean treatment augmented, such phenomena could be the reflect of the treatments on anti-nutritional factors present in the soybean. On the other hand the shell resistance was reduced as the temperature was increased ($p<0.05$).

Table 1: Nutritional value of full fat soybean processed at different temperatures

Thermal treatment, °C	Urease activity	Crude protien, %	Crude fat, %	Starch gelatinization,%
84	2.00	35.37	20.09	13.96
98	1.97	36.13	19.98	15.08
110	1.27	36.46	20.29	22.10
120	0.56	35.29	20.24	19.27
124	0.14	36.22	20.46	28.32
132	0.00	35.27	20.66	27.84

Table 2: Productivity of hens fed soybean meal treated with different temperatures

Thermal treatment, °C	Egg number	Feed intake, kg	Egg yield, kg	Feedt to egg mass	Shell resistance resistance,kgcm^{-2}
84	204	18.282	10.736	1.70	4.433
98	191	19.453	10.042	1.94	4.418
110	199	20.283	10.776	1.88	4.321
120	211	19.450	11.084	1.75	4.218
124	208	19.868	11.467	1.73	4.253
132	223	21.070	12.111	1.74	4.110

CONCLUSION

Increasing the temperature of soybean seed treatment even though needs extra energy investment has little effect on laying hen production.

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