Physiological response in rats consuming crude cowpea (*Vigna unguiculata*) grains meal as substitute for commercial soybean. Blood indices

L.A. Aguirre, Lourdes Savón, Y. Santos and L.E. Dihigo

Instituto de Ciencia Animal, Apartado Postal 24, San José de las Lajas, La Habana

Thirty-six male Sprague-Dawley rats of 100 ± 5 g of liveweight were selected according to a random block design with three replications. There were six rats per treatment. The experiment was conducted to study the effect of consuming *Vigna unguiculata* (INIFAT-93 variety) crude grain meals as substitute for commercial soybean cake on the performance of blood protein indices. Five levels of substitution (20, 40, 60, 80 and 100 %) were used in a basal diet of soybean-maize. There were no differences due to the treatment effect on the indices hemoglobin (Hb), hematocrits (Ht), differential count of leukocytes, serum concentration of albumen and cholesterol and alanine amino transferase activity (ALAT). All were reported within the normal ranges of good health. However, there was a decline in the serum concentrations of total proteins (from 6.7 to 6 g/dL) and their globulin fraction (from 2.8 to 2.4 g/dL) above the 80 % substitution of soybean by cowpea, which could be due to a decline in the protein quality of the diet. It is concluded that it is physiologically possible to substitute the commercial soybean cake by crude cowpea grain meals up to 60 %, without affecting the blood indices of the state of protein repletion of the animals.

Key words: *serum biochemical indices, blood indices, protein quality, rats, cowpea, soybean*.

Cowpea (*Vigna unguiculata* var. INIFAT-93) is a promising legume for farm animal feeding. Therefore, different experiments have been developed to determine the nutritive quality of its grains (Aguirre *et al.* 1998 and Aguirre *et al.* 1999). However, there are few studies on the effect of the consumption of these grains on the blood indices of protein repletion during a prolonged period of time.

The aim of this experiment was to study the effect of substituting commercial soybean cake by crude cowpea grain meal on the physiology of rats, as model of non-ruminant animals, and on the blood indices that describe the health state and protein repletion of the animals. These indices are more easily affected by unbalances in the nitrogen supply of the ration.

Materials and Methods

Thirty-six male Sprague-Dawley (conventional) rats of 100 ± 5 g of liveweight were selected and provided by the National Center of Laboratory Animals (CENPALAB). They were distributed according to a random block design with three replications, six rats per treatment. They were free of 11 bacteria, endoparasites and seven viruses (tested), according to this center.

Cowpea and experimental diets composition was described by Aguirre *et al.* (2002).

Experimental procedure. After 15 d consumption of the experimental diets, blood samples were collected from the animals by puncture of the jugular vein for the analysis of hemoglobin (Hb), hematocrit (Ht) and the differential count of leukocytes: lymphocytes, monocytes, basophiles, eosinophiles and neutrophiles. In their respective sera, of four animals per treatment the biochemical indicators: concentration of total proteins (method of Biuret), their fractioning according to the albumin reaction with bromocresol green (the fraction of globulins constitutes the rest of the total protein) and the activity of alanine amino transferase (ALAT) by means of the NADH

oxidation by the action of lactatodihydrogenase, that binds with the reaction of conversion of alanine in piruvate, and the concentration six total cholesterol by the method of the reaction of esthers cholesterol hydrolisis (reaction of peroxide relased by the action of piroxidase).

Statistical analysis. The statistical analysis corresponded with the design selected. Duncan's (1955) multiple range test was used in the necessary cases.

Results and Discussion

Table 1 shows the results obtained in the blood indices. The values of Hb and Ht were not affected by any treatment and had normal ranges from 10 to 12 g/dL for Hb and from 33 to 40 % for Ht (Gupta *et al.* 1992). A similar performance was found in the differential count of leukocytes, coinciding with studies on this species (Gupta *et al.* 1992). Although a slight increase in monocytes in the treatment of 100 % vigna was observed, which could be due to some viral infection (Lynch *et al.* 1979), this increase may not be associated with our experimental premises. The stability of all these indicators showed, from the hematoclinical point of view, animal welfare at the end of the experimental period.

The biochemical indicators determined (table 2), total serum proteins and, specifically the globulin fraction were affected by the increase of up to 80 % cowpea inclusion, compared to the control and the values reported as normal (from 6.2 to 7.0 g/dL) (Doongaji and Vali 1992 and Gupta *et al.* 1992). This is an expected performance according to the decrease in the apparent fecal digestibility and the ratio of protein efficiency (Aguirre 2002). The content of total protein circulating and the free amino acids pool decrease by reducing the quality of the diet protein with the gradual increase of cowpea inclusion. Out of the two main fractions of total proteins, globulins were most affected by low quality protein. The other fraction, including albumins, is more important in the blood protein transportation and more dependent of the hepatic dysfunctions. The ALAT and cholesterol values were within normal ranges for this species in all the treatments (Long 1961 and Vetési *et al.* 1992), which prove that the liver and the pancreas were in good enzymatic state.

Likewise, the consumption of crude cowpea grain meals as substitute for commercial soybean cake did not affect the main blood indices of the rats up to 60 % inclusion. It is concluded that this level of inclusion is feasible for rat diets as model of non-ruminant animals.

Table 1. Blood indices

Indices	Treatments (% of soybean substitution by cowpea)						SE ±
	Control	20 %	40 %	60 %	80 %	100 %	
Hb, g/dL	11.38	11.88	12.19	12.88	10.37	11.89	1.29
Ht, %	37.5	34.2	40.2	42.5	34.2	39.2	1.27
Differential count, %							
Lymphocytes	0.88	0.85	0.83	0.79	0.89	0.84	0.03
Monocytes	0.012	0.010	0.007	0.012	0.007	0.030	0.007
Basophiles	0	0.010	0.005	0.005	0.003	0.003	0.0003
Eosinophiles	0.007	0.002	0.001	0.003	0.005	0.003	0.0004
Neotrophiles	0.08	0.18	0.14	0.16	0.12	0.12	0.03

Table 2. Serum biochemical indices

Indices	Treatments (% of soybean substitution by cowpea)						SE ±
	Control	20 %	40 %	60 %	80 %	100 %	
Total protein, g/dL	6.77[a]	6.60[a]	6.72[a]	6.57[a]	6.17[b]	5.96[b]	0.18*
Albumins, g/dL	3.91	3.87	3.77	3.77	3.54	3.57	0.11
Globulin, g/dL	2.86[a]	2.72[a]	2.94[a]	2.80[a]	2.64[ab]	2.39[b]	0.11*
ALAT, u/L	30.4	41.4	31.8	29.5	24.6	20.24	7.4
Cholesterol, mg/dL	91.8	99.19	103.3	108.5	105.18	94.77	4.81

[ab]Different letters within the same row differ at $P < 0.05$ (Duncan 1955)
* $P < 0.05$

Acknowledgements

Thanks are given to the laboratory technicians Alba Montejo and Milbis Cueto for the analyses made and to Dr. María F. Díaz for seed supply.

References

Aguirre, L.A., Savón, L., Dihigo, L.E. & Santos, Y.1999. Protein quality of raw grain meal of five *Vigna unguiculata* varieties in growing rats. Cuban J. Agric. Sci. 33:395

Aguirre, L.A., Savón, L., Oramas, A., Dihigo, L.E. & Rodríguez, V. 1998. Protein quality of raw soybean (*Glycine max*), Vigna (*Vigna unguiculata*) and canavalia (*Canavalia gladiata*) meal in growing rats. Cuban J. Agric. Sci. 32:75

Aguirre, L.A., Savón, L., Santos, Y. & Dihigo, L.E. 2002. Protein metabolism and productive performance of rats consuming raw cowpea (*Vigna unguiculata*) grain meal to substitute commercial soybean cake. Cuban J. Agric. Sci. 36: 159

Doongaji, S. & Vali, S.1992. Effect of wheat germ supplement to flour mixtures on growth, serum and liver proteins of weanling albino rats, J. Food Sci. Technol. 29:125

Duncan, D.B.1955. Multiple range and multiple F tests, Biometrics 11:1

Gupta, K., Barat, G.K., Wagle, D.S. & Dhindsa, K.S.1992. Effect of conventional and non-conventional green leafy vegetables on haematological indices and blood constituents of rats. J. Food Sci. Technol. 29:182

Long, C. 1961. Biochemists' Handbook. Eds. E. & F. N. SPON Ltd. London, UK

Vetési, M., Mézes, M., Gáal, T. & Baskay, G. 1992. Effect of bulk feeds (alfalfa hay, corn silage) on the metabolism and liver parameters of growing geese. Acta Veterinaria Hungarina 40:231

Received: March 12, 2001.