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Protein Digestibility and Trypsin Inhibitor Activity of Legume Seeds. (18150)

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The poor nutritional quality of some crude legumes has been attributed in early studies to low digestibility(1) and it has been shown that *in vitro* digestibility of crude beans is lower than that of cooked beans(2). Later, factors have been found in a number of crude legumes which inhibit the *in vitro* activity of trypsin(3). However, a purified trypsin inhibitor from soy beans did not inhibit growth of rats and chicks(4). Moreover, no correlation between improvement of growth promoting action of legumes after autoclaving and their trypsin inhibitor content was found in a recent study(5). Some legumes contain heat labile factors which inhibit growth and are probably not identical with trypsin inhibitors(6). No correlation could be detected between growth depression by crude legume seeds and their trypsin inhibitor activity(7). It therefore seemed to be of interest to study the *in vivo* digestibility of some legumes in the crude and autoclaved form and to compare them with their activity to inhibit the action of trypsin *in vitro*.

Experimental. The protein digestibility experiments were made with young Sprague-Dawley rats of about 100 g of weight. For each experiment 2 male and 2 female rats were housed in single screen bottomed cages. Food and water were given *ad libitum*. Food consumption was determined and feces were collected every 3 days, dried at 70°C, weighed, and analysed for N. With the mentioned exceptions, the diets were composed mainly of starch and the amount of the dried and

1. Johns, C. O., and Finks, A. J., *J. Biol. Chem.*, 1920, v41, 379.
2. Waterman, H. J., and Johns, C. O., *J. Biol. Chem.*, 1921, v46, 9.
3. Borchers, R., and Ackerson, C. W., *Arch. Biochem.*, 1947, v13, 291.
4. Borchers, R., Ackerman, C. W., and Mussehl, F. E., *Arch. Biochem.*, 1948, v19, 317.
5. Borchers, R., and Ackerson, C. W., *J. Nutr.*, 1950, v41, 339.
6. Jaffé, W. G., *Experientia*, 1948, v5, 81.
7. Jaffé, W. G., *Acta Cient. Venez.*, 1950, v1, 16.

TABLE I. True Digestibility of Proteins of Some Crude and Autoclaved Legumes in Growing Rats and Their Trypsin Inhibitor Activity.

Legume	Scientific name	Digestibility		Trypsin inhibitor 10^{-4} units/g
		Crude	Autoclaved	
Black kidney beans	*Phaseolus vulgaris*	64.0	76.5	3.90
Red kidney beans	" "	56.0	79.5	4.25
Hyacinth beans	*Dolichos Lablab*	56.5	81.6	4.38
Soy beans	*Glicino soya*	70.1	85.4	4.15
Lima beans	*Phaseolus lunatus*	34.0	51.3	4.04
Pigeon peas	*Cajanus indicus*	59.1	59.9	2.77
Cow peas	*Vigna sinensis*	79.0	82.6	1.91
Lentils	*Lenis esculenta*	88.3	92.6	1.78

ground seeds to contain 10% of crude protein (Nx 6.25); the composition of these diets and the treatment of the legume seeds was the same as described earlier(8). The crude kidney beans and hyacinth beans were assayed as a mixture of 20% of the seeds with 80% of a commercial rat diet of known digestibility. This technic, although less accurate, had to be adopted as these seeds are toxic for rats and food consumption was very low when they were administered in the same diet as the other legumes studied. In a separate experiment, the protein digestibility of cooked kidney beans was determined using both experimental diets; the results differed only by 0.8%. To compute the true digestibility from the values of apparent digestibility, the endogenous nitrogen excretion in the feces of the strain of rats used was determined separately and found to correspond to an excretion of 1.25% of crude protein. This value was used for all the calculations. The digestibility of each sample was determined from 3-8 times with 1-4 groups of rats. The results given in Table I are the averages of these experiments. Trypsin inhibitor activity was determined according to the technic of Borchers and Ackerson(3).

Most of the legume samples were obtained from the Genetical Division of the Ministry of Agriculture. The samples of hyacinth beans and of lima beans were purchased in Barqusimeto and are local varieties. The lentils were bought at the local market from an imported lot.

Results. The results are summarized in Table I. Only in kidney beans, soy beans, lima beans and hyacinth beans, a significant difference in the protein digestibility between the crude and autoclaved legumes could be detected. These samples had trypsin inhibitor activities of more than 3×10^{-4} units/g. All the other samples studied were less active in inhibiting trypsin action *in vitro* and the proteins of these seeds were nearly equally well digested whether given crude or autoclaved. Waterman and Johns(2) found a difference of the *in vitro* digestibility between raw and autoclaved kidney beans of about 15% which is in fair agreement with the *in vivo* values found in this study.

The digestibility of the lima bean sample was surprisingly low. The pigeon peas had also an unusual low digestibility coefficient; we have described recently the great variability found in different varieties of this legume in respect to the digestibility of its proteins(9). The sample of lentils studied was fairly active in inhibiting the action of trypsin *in vitro* while Borchers and Ackerson (3) found this legume to be inactive in this respect.

Summary. Protein digestibility of raw and autoclaved legume seeds were determined in growing rats and the trypsin inhibitor content of the same seeds was measured *in vitro*. The proteins of kidney beans, soy beans, lima beans, and hyacinth beans were 12-25% more completely digested when autoclaved as compared with the raw seeds. These samples had also the highest trypsin inhibitor activities.

8. Jaffé, W. G., PROC. SOC. EXP. BIOL. AND MED., 1949, v71, 398.

9. Jaffé, W. G., *Arch. Venez. Nutr.*, 1950, v1, 107.

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