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## Comparative Solubility of Protein in Cottonseed Flakes Extracted by Hexane and by Ethanol at Two Different Temperatures

LIONEL K. ARNOLD and R. BASU ROY CHOUDHURY<sup>1</sup>

*Abstract.* The solubility in water, in 3 percent sodium chloride solution, and in 0.2 N sodium hydroxide solution of cottonseed flakes extracted by ethanol at 172° F. is lower than similar flakes extracted by hexane at 146° F. Data are presented which indicate the lower solubility is mainly the result of the differences in the solvents rather than the temperatures. The difference in solubility in the sodium hydroxide solution is less than in the sodium chloride solution.

The comparative solubilities of the proteins in hexane- and ethanol-extracted cottonseed flakes were previously reported from this laboratory by Arnold and Schriver (1958). These data showed lower protein solubilities in water, in 3 percent sodium chloride solution, and in 0.02 N sodium hydroxide solution for flakes extracted by hexane. Since the ethanol extraction was carried out at an average temperature of 172° F. and the hexane extraction at 146° F. it was not possible to determine how much of the solubility decrease resulted from the ethanol and how much from the higher temperature. The current work was initiated to determine this.

**Table 1**  
Proteins in Extracted Cottonseed Flakes

Protein Content Per Cent	Extraction Solvent				
	Hexane		95% Ethanol		
	146° F.*	140° F.	172° F.*	175° F.	140° F.
Total	56.4	56.4	61.5	61.2	61.8
Soluble in water	11.9	11.9	7.9	7.9	9.1
Soluble in NaCl solution	40.5	40.5	31.7	32.2	33.4
Soluble in NaOH solution	44.9	44.9	43.1	43.0	41.0
Solubility of Protein Per Cent**					
In water	21.1	21.1	12.9	12.8	13.2
In NaCl solution	71.8	71.8	51.5	52.5	54.5
In NaOH solution	79.6	79.6	70.1	70.2	72.2

\*From Arnold and Schriver (1958). Temperatures are average values.

\*\*Numerically equivalent to nitrogen solubility.

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## EXPERIMENTAL PROCEDURE

The general experimental procedure was similar to that reported in the previous paper. The extraction apparatus was larger, allowing the use of a 100-gram sample. Extraction time was 100 minutes with solvent sufficient to produce 1000 ml. of miscella. The hexane was the extraction grade.<sup>2</sup> The temperatures used were 140° F. with the hexane and 140° F. and 175° F. with the ethanol. The solubilities in water, in 3 percent sodium chloride solution, and in 0.02 sodium hydroxide solution were determined by the same procedures previously used.

## DISCUSSION

The results from both the previous and current work are summarized in the table. These indicate that the lower solubilities of the ethanol-extracted flakes or meals resulted mainly from the effect of the solvent rather than the extraction temperature.

In general, the solubility data indicate that the hexane-extracted cottonseed meal should be a better feed than the ethanol extracted meal. However, there is no indication from these studies of the effect on the solubility of the heating in the desolventizing process subsequent to extraction in commercial processing. It should also be kept in mind that ethanol should remove most of the toxic gossypol which is not affected by the hexane. Further it has been stated (Chang *et al.*, 1955), that for chick feeding the solubility of the protein in 0.02 N sodium hydroxide is a better indication of protein quality than solubility in dilute sodium chloride. The difference in solubility of the flakes extracted by the two solvents in the sodium hydroxide solution is less than in the sodium chloride solution.

## Literature Cited

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<sup>2</sup>Phillips "High Purity Normal Hexane."