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ANALYSIS OF CHANGES IN COTTON SEED PULP DUE TO HYDROTHERMAL TREATMENT

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Annotation: During the hydrothermal treatment and roasting phase of cotton seed pulp, physical and chemical changes occur in the substances contained in the pulp. These changes are particularly evident in proteins and gossypol. The primary cause of these changes is the increasing moisture and temperature applied to the pulp.
Keywords: Cotton seed, gossypol, hydrothermal, inactivator, protein, temperature.

Objective: To improve the process of hydrothermal treatment of cotton seed pulp and enhance the quality of the obtained products.

Relevance: Currently, one of the key issues in processing cottonseed into primary products is reducing free gossypol in pressed and extracted oils and minimizing the degree of protein denaturation in meal, which is the main nutritional component of the final product. It is well known that any impact, whether physical, chemical, mechanical, or otherwise, inevitably leads to subsequent changes. In the oil and fat industry, many influencing factors and their consequences can be observed during raw material processing. Proper study and selection of these effects determine the quality and quantity of the product, whereas neglecting or failing to study them may lead to reduced production efficiency. Therefore, monitoring changes occurring during oil extraction is of great importance. The most intense and diverse effects in cottonseed processing occur during the hydrothermal treatment and subsequent roasting of the pulp.

During hydrothermal treatment, the core of oil-bearing seeds undergoes physical and chemical changes. Initially, the heat treatment process of the cotton seed pulp is conducted using steam. Sharp water vapor ensures the supply of moisture and heat to the pulp. As a result of hydrothermal treatment and roasting, significant physical and chemical changes occur in the properties of oils, proteins, carbohydrates, and gossypol compounds present in the cotton seed pulp.

The temperature applied to the cotton seed pulp also affects its protein content. During our experiments, we observed that the degree of protein denaturation varied depending on the roasting conditions, as illustrated in Table 1.

Table 1
Protein Denaturation in Cotton Seed Pulp During the Roasting Phase

Sample Name	Relative Humidity (%)	Temperature (°C)	Protein Content (%)	Water-Soluble	10% NaCl Solution	0.2% NaOH Solution
Experiment I						
Before roasting	11.03	57-62	44.71	6.90	14.45	23.36
After roasting	6.06	90-95	26.41	3.81	8.67	13.93
Experiment II						

Before roasting	12.17	65-70	55.7	7.94	17.85	29.91
After roasting	6.33	100-105	21.7	3.40	6.72	11.58

In the first experiment, before roasting, the moisture content was 12.17% at 57-62°C, and after roasting, the moisture content was 6.33% at 90-95°C. As a result, the protein content decreased from 44.71% to 26.41%. In the second experiment, where the moisture level remained relatively unchanged but the temperature increased by 10°C, we observed that protein content was almost halved.

Additionally, we found that when the moisture content of cotton seed pulp was maintained at 11-13% and roasted at 100-105°C for 60-80 minutes, gossypol also underwent various changes. These results are presented in Table 2.

Table 2

Changes in Gossypol Content in Cotton Seed Pulp Due to Heat Treatment

Product Name	Moisture (%)	Temperature (°C)	Gossypol Content (%) (Relative to Dry Defatted Material)
Experiment I			
Before inactivator	6.2-7	25-30	2.1-1.92
After inactivator	10-12	57-62	1.9-1.1
After roasting	6-7	90-95	0.97-0.66
Experiment II			
Before inactivator	6.4-7.3	30-35	1.97-1.73
After inactivator	11-13	65-70	1.7-1.07
After roasting	6.8-7.2	100-105	0.88-0.27

Conclusion: Our experiments have demonstrated that moisture and temperature, which influence protein denaturation, also significantly affect gossypol content. High levels of moisture and temperature resulted in a reduction of gossypol content to 0.88-0.27%.

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