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Optimizing the operating parameters of cooker during oil extraction and production of sunflower meal on an industrial scale

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Introduction: Using oilseeds in the human food stuffs, employing their meal for animal feed and also their usage in pharmaceuticals, soap making and fuel has prompted great interest for farmers to plant them and for the government to promote their cultivation. Among them, sunflower is one of the main oilseeds in the world which its cultivated area has expanded due to fair cultivation requirements, high yield of the oil, high nutritional value and also lack of anti nutritional factors. Sunflower (Helianthus annuus) is an annual plant belonging to Asteraceae family. This is a dicotyledonous, cross-pollinated monoecious plant that is fertilized by wind and insects. Sunflower seed oil has an excellent nutritional quality, as in recent years, cultivars with high oil (especially oleic acid) content have been substantially nurtured. The most different methods of extracting oil from oilseeds are the press and solvent methods. Similar to the other seeds with high oil content such as canola, the most effective way of extracting oil from sunflower is mechanical pressing followed by solvent extracting. In this method, the mechanical press extracts about 60 percent of the oil and the solvent method extracts the remaining oil. For the first time, the present study was aimed to improve temperature of cooker and moisture of output seeds for producing sunflower oil with lowest degree of insoluble fine partial in oil, moisture and acidity and meal with lowest levels of moisture and oil.

Materials and Methods: Sunflower seeds used in this research were supplied from one of Iran's provinces and were transferred to the company of Khorasan cotton and oilseeds to produce oil and meal. After receiving the sunflower seeds in the factory, they were entered into silos in dark and ambient temperature; impurities such as dust, sands, stones, spoiled seeds, small weed seeds and other extraneous materials were separated by mechanical sieves. After cleaning, the seeds were entered into the cracker and they were broken into smaller particles and then were moved into the cooker; at this stage, the temperature of cooker and moisture content of the exiting seeds were set to 70, 80 and 900 C, and 7, 7.5 and 8%, respectively. Then, conditioned seeds were entered into the Buhler flicker device for flaking. Afterwards, the flakes were moved into the Desmet extractor (heating condition of 500C for 7 hours) to extract the oil from the seeds by hexane solvent. Then, the tests were performed on the oil and meal. Severalphysic-chemical properties of sunflower oil including insoluble fine partial, acidity values as well as moisture, protein and oil contents of the obtained meals were determined. Statistical analysis and process optimization were carried out using response surface methodology (RSM).

Results and discussion: The achieved results expressed that with an increase in cooking temperature, insoluble fine partial and oil acidity values of the extracted oil were boosted while moisture content of oil and meal values alongside oil content of the obtained meal showed reduction. With increasing of the moisture content of cooker's seeds, the insoluble fine partial value of the extracted oil was reduced while oil acidity value was increased. Increasing the moisture of cooker'sseeds led to the oil reduction in the meal. The highest oil content in the meal was achieved in the condition that the cooker temperature was 70oC and the moisture of output seeds from the cooker was 7%. The analysis of resulted data showed that two parameters of the cooker's temperature and cooker's seeds moisture content had significant effects on the moisture content of the meal. Increasing the cooker temperature from 70 to 90oC caused a decrease in the meal moisture. As result shown, increasing the moisture content of output seeds from the cooker increased the moisture content of the meal. Increasing the cooker temperature from 70 to 90oC reduced the protein amount of the meals. Results of different

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studies showed that increasing the temperature will decrease the protein amount of the meals. Increasing the moisture was also resulted in the decrease of residual protein in the meal. The obtained results of the optimization procedure revealed that the application of the cooking temperature of 70 °C and moisture content of the output seeds equal 7.73 and 7.65 % led to achieving products with the least values of acidity and insoluble fine partial in the obtained oil as well as meals with the minimum remaining oil.

Key words: Cooker, Industrial scale, Operating parameters, Optimization, Sunflower oil