LOW-TEMPERATURE GRINDING OF SPICES (TURMERIC)

ABSTRACT

Key words: Spices, Grinding, Volatile oil, Low-temperature grinding mill, Pin mill

India is ‘The Land of Spices’ and the glory of Indian spices are known throughout the world. Grinding is a very important step in the post-harvest processing of spices requiring special attention in order not to lose the aroma and flavour compounds present in them. During grinding, the temperature of the product rises to a level in the range of 42-95°C; spices lose a significant fraction of their volatile oil or flavouring components due to this temperature rise. The objective of this study was to develop a low temperature grinding mill for grinding of spices. For cutting of turmeric in small pieces pin mill was also designed and developed.

Physical and mechanical properties of turmeric was determined at different moisture content relevant for the design of pin mill and development of low temperature grinding mill namely size, bulk density, true density, porosity, angle of repose coefficient of friction and rupture force. Development of pin mill was done for cutting turmeric of average length, width and thickness 54.46 ± 2.34, 12.48 ± 0.45 and 11.32 ± 0.39 mm, respectively into the pieces of average length, width and thickness of 9.10 ± 0.51, 6.37 ± 0.29 and 4.72 ± 0.32 mm, respectively.

During design of low temperature grinding mill, Firstly design of cooling coil (evaporator) was done by considering dimension of grinding chamber. It was fixed on the grinding chamber. Then calculation of cooling load was done. On the basis of this refrigeration load, selection of refrigerant and compressor, design of capillary tube and condenser was done.

Performance evaluation of grinding mill was done by grinding the turmeric at three different temperatures and at three different moisture contents of turmeric rhizome compared with control treatment. Temperature increased rate was slow during low temperature grinding as compare to ambient grinding. Temperature increased rate was also decreased with decreasing moisture content of turmeric rhizome because of effect of evaporative water cooling. Temperature inside the mill at the end of grinding and flour temperature decreased with decreased in grinding temperature and increased in moisture content turmeric rhizome. Time to set grinding temperature increased with decreased in grinding temperature, while milling loss decreased with increased in moisture content turmeric rhizome.
Biochemical analysis of low temperature ground turmeric and ambient ground turmeric was done. Volatile oil, moisture content, true protein, total carbohydrate and fat content increased with decrease in grinding temperature and increase in moisture content of turmeric rhizome. Moisture content added not directly affects on this nutritional parameter but it reduces temperature during grinding due to evaporative water cooling effect. Retention of volatile oil was more in low temperature treatment turmeric powder compared to ambient grinding turmeric powder. GC-MS analysis showed that, there was more retention of volatile oil component in low temperature ground sample than ambient ground sample.

Sensory analysis of ground turmeric at various treatments and ambient ground turmeric was reported that, low temperature ground at higher moisture content gives better colour, odour, flavour, appearance and taste compared to ambient ground powder. The cost of grinding without cooling system of 1 kg of turmeric was found to be ₹ 10.84 and payback period was 277.18 hr while cost of grinding with cooling system was ₹ 12.12 and payback period was 310.17 hr.