

Development and Performance Evaluation of a Summer Squash Seed Extracting Machine

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Abstract: A low-cost summer squash (*Cucurbita pepo* L.) seed extraction machine was locally designed, manufactured and evaluated. Seed extraction by the machine was conducted by first crushing the vegetables, then separating seeds from flesh, skin and other vegetable materials. The performance of the developed machine was evaluated based on seed loss, broken seeds, machine extraction efficiency and specific energy requirements. The evaluation was conducted at different operation conditions including different crushing drum speeds (ranging from 5.23 to 9.16 m/s), feed rates (ranging from 300 to 1200 kg/h) and wet-based (wb) vegetable moisture contents (MC) (ranging from 82.03 to 93.54%). Results revealed that the seed loss was proportional to the feed rate and inversely proportional to the MC. At all other variable levels, the minimum loss was found at a drum speed of 6.54 m/s. The broken seeds, however, were found to decrease with increasing feed rate and MC and increase with increasing drum speed. The maximum percentage of broken seeds was less than 1.3. For the extraction efficiency, it was found to be proportional to the MC and inversely proportional to the feed rate approaching its maximum value at a 6.54 m/s drum speed with all other variable levels. For all values of drum speed and feed rate, the specific energy required by the machine was found to be inversely proportional to the vegetable MC. At a specific MC, the specific energy was found to be proportional to drum speed and inversely proportional to feed rate. Increasing the feed rate from 300 to 1200 kg/h decreased the required energy from 83 to 38 kW.h/t. Operation cost analysis showed that the extraction cost by the machine was at 20.83 \$/ton compared to 192 \$/ton for manual seed extraction, hence, a saving of above 89% can be achieved using the developed machine.

Key words: Summer squash • Seed extraction • Operation conditions • Performance evaluation • Extraction cost

INTRODUCTION

Summer squash (*Cucurbita pepo* L.) is a very popular vegetable in Egypt, where the current cultivated area of this crop reached above 42000 ha [1]. Summer squash is cultivated for different reasons, one of them is to extract the seeds to be used and marketed as edible seeds, where an average seed yield of 1.1 t/ha can be obtained [1]. This agricultural product (summer squash seeds) is considered

in Egypt to have a satisfying commercial value and a potential to be exported as a commercial commodity.

Seed from the summer squash can be extracted using either a dry or a wet method. In the dry method, the dried vegetable is cut from one side where the seeds can flow out. However, the vegetable in the wet method is cut longitudinally and seeds are scooped out. In the wet method, seed extraction can be either mechanical, by natural fermentation or chemical extraction [2].

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