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Design, Fabrication and Performance Evaluation of a Melon Shelling Machine

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ABSTRACT

Melon is a notable oil-seed crop widely planted in Tropical Africa for both consumer and industrial uses. Shelling is a very necessary postharvest practice prior to its vast applications. To address the problems associated with its shelling, a melon shelling and cleaning machine was developed using local materials. The machine consists of a frame, hopper, shelling and cleaning unit, prime mover, and chutes. The performance operation was carried out using "serewe" melon seeds. The processing involves different operations which include shelling and cleaning (separation of the seed from the chaff). The machine was tested at three different moisture content (12%, 16%, and 20%). The shelling speed was varied at 750rpm, 950rpm, and 1500rpm respectively. The machine's throughput Capacity per hour (C_{mph}) was 293.3 kg/hr and the grain recovery range of 87.8%. The optimum shelling and cleaning efficiencies were obtained at 20% moisture content at a shelling speed of 950rpm which gives shelling and cleaning efficiencies of 92.2 and 60.2% respectively.

Keywords: *Cleaning, Moisture, Melon, Seed, Speed*

1 INTRODUCTION

Melon (Citrullus Species), also known as "egusi" in Yoruba, is one of the significant oil-seed crops that are farmed and consumed in tropical Africa (Olaoye & Aturu, 2018). It is a tendril-climbing annual herbaceous crop that thrives in some areas of Nigeria's Savannah belt (Adekunle et al., 2009). Melon seed is incredibly nutritious and provides the human diet with high-quality proteins (Sobowale et al., 2015). It contains essential amino acids of about 41.51% and other essential nutrients. It is also a good source of vitamins, minerals, oil, and energy in form of carbohydrates. The seed contains 4.6g of carbohydrates, 0.6 of proteins, 33 mg of vitamin C, 230 mg of K, 17 g of Ca per 100 g edible seeds, 16 mg of P, 0.6 g of crude fiber, and unsaturated fatty acids. The seed kernel (Egusi) is the main ingredient in a number of soups, where it thickens, emulsifies, binds fat, and imparts flavor (Olaoye & Aturu, 2018).

Due to its ability to control weeds, crops including maize, okra, cassava, and yam can be grown alongside it as an intercrop. With proper management, it can be harvested between two and a half and three months after planting, with a potential seed yield of 350–400kg per hectare. Nigeria is home to the cultivars Bara, Serewe, and Sofin. Large brown seeds with thick black margins that thicken at the apex make up the 16 x 9.5mm bara, also known as papa, which is widely grown in northern and western Nigeria. While the smooth, light brown Serewe seeds are approximately 15 mm by 9 mm and have a thin, light whitish edge. The fruits have virtually spherical external surfaces and are formed of a white fleshy substance with a little, flat seed implanted inside (Nwosu, 1988). According to an examination of melon seeds conducted by Ajibola et al., (1990), melon seeds contain roughly 50% of oil by weight, 37.4% of protein, 2.6% of fiber, 3.6% of oil, and 6.4% of moisture. The seed's oil is composed of 50% of unsaturated fatty acids, such as linoleic acid (35%), oleic acid (15%), and 50% saturated fatty acids, such as stearic acid and palmitic acid. It is mostly grown for its shelled kernel, which is the intended usage. This can be crushed into a thick paste and added as a garnish to soups and stews. Additionally, it is incorporated into goods like "Ogiri" baby "Robocake," animal fodder, and its oil is used to make local pomade and soap (Shittu and Ndrika, 2012).

To further diversify melon's uses, processing is essential. This comprises drying, fermenting, drying, washing, coring, and oil extraction. Shelling is the process of removing the melon kernel's husk, or outermost layer. Consequently, the seed and prickly husk are separated. This procedure can be performed outside or at a storage environment (Nwakire et al., 2011). In Nigeria, melon shelling and winnowing are still done by hand, employing ancient methods like pounding the melon against a stone or hard surface to crack open the seeds (Olaoye & Aturu, 2018). Various studies on the creation and development of shellers have been conducted. Nevertheless, there is still a need for advancement in the mechanization of melon (egusi) shelling equipment. Due to their sophistication, poor output, and lack of a cleaning unit, the existing