Design and Fabrication of Mango Seed Deshelling Machine

Pranit Parab[1], Sameer Manjrekar[2], Shubham Patil[3], Roshan Padelkar[4], Prof. S.V. Vanjari[5]
[1, 2, 3, 4, 5] Dept of Mechanical Engineering
[1, 2, 3, 4, 5] S.S.P.M college of Engineering Kankavli

Abstract- *the overall purpose of study is to design and fabricate a machine which will effectively deshell the mango seed and separate the kernel from the shell. The mango fruit is the most produced and processed fruit in kokan region. It has a seed at the centre which has multiple uses. The size of this seeds varies with fruit type.*

Keywords- kernel, shell, cutting tool

I. INTRODUCTION

Mango seed has multiple uses in medicine and oil. The mango is a common tropical fruit usually found in southern and south East Asian countries. Cultivated in many tropical regions and distributed widely this fruit has been extensively exploited for food, juice, color and some special ingredients found in super foods.

Mango trees (Mangifera indica) reach 35 - 40 m in height, with a crown radius of 10 m. The leaves are evergreen, alternate, simple, 15 - 35 cm long and 6 - 16 cm broad; when the leaves are young they are orange-pink, rapidly changing to a dark glossy red, and then dark green as they mature. The fruit takes from 3 - 6 months to ripen. The ripe fruit is variable in size and color, and may be yellow, orange, red or green When ripe, depending on the cultivation. When ripe, the unpeeled fruit gives off a distinctive resinous sweet smell. In its center is a single flat oblong seed that can be fibrous or hairy on the surface, depending on the cultivar.

II. MANGO SEED

Mango seed is a flat single oblong seed that have fibouros hair on surface , depending on the cultivation. Inside it there is coat 1 - 2 mm thick is a single embryo covered in thin lining, 4

- 7 cm long, 3 - 4 cm wide, and 1 cm thick. It consists of a tenacious coat enclosing the kernel. The seed content of different varieties of mangoes ranges from 9% to 23% of the fruit weight (Palaniswamy et al., 1974) and the kernel content of the seed ranges from 45.7% to 72.8% (Hemavathy et al., 1988). The results of proximate analysis of mango seed kernel are shown in table 2. The results showed that mango seed kernel contain crude protein, oil, ash, crude fiber, and carbohydrate. Due to the differences in variety of plant, cultivation climate, ripening stage, the harvesting time of the seeds kernels and the extraction method used variation in mango seeds.

Table 1. Different components obtained during mango pulp extraction

Component	Percentage
Mango pulp	45–65
Peels	15–20
Pulpier waste	10–15
Stones	10–20

(Source: Central Food Technological Research Institute, 1985)

Table 2. Proximate analysis of mango seed kernel

Characteristic	Reported values (Mean)			
	Nzikou *et al.*, 2010	Dhingra and Kapoor, 1985[1]	Dhingra and Kapoor, 1985[2]	Changso, 2008
Moisture content (%)	45.2	38.55	50.98	40.5
Crude protein (%)	6.36	5.34	5.25	1.43
Fats /oils (%)	13.0	7.82	6.98	4.92
Crude fiber (%)	2.02	1.75	1.65	3.96
Ash content (%)	3.2	2.75	2.47	0.83
Total carbohydrate (%)	32.24	nr	nr	48.19

Note: nr, not reported
Dhingra and Kapoor, 19851 variety Chausa
Dhingra and Kapoor, 19852 variety Dusheri

Table 3. Mineral elemental composition of mango seed kernel (mg/100g)

	Nzikou *et al.*, 2010	Fowomola, 2010
Calcium, Ca	10.21	111.3
Magnesium, Mg	22.34	94.8
Potassium, K	158.0	22.3
Sodium, Na	2.70	21.0
Phosphorus, P	20.0	nr
Iron, Fe	nr	11.9
Zinc, Zn	nr	1.10
Manganese, Mn	nr	0.04

Note: nr, not reported

A. Mineral composition of seed

From composite analysis it was found that mango seed kernel was high in potassium, magnesium, phosphorus, calcium and sodium (Table 3). Potassium is an essential nutrient and has an important role in the synthesis of amino acids and proteins (Malik and Srivastava, 1982). Calcium and magnesium plays a significant role in photosynthesis, carbohydrate metabolism, nucleic acids and binding agents of cell walls (Scalbert, 1991). Calcium supports in teeth

development (Brody, 1994). Magnesium is important mineral for enzyme activity, like calcium and chloride; magnesium also plays a role in regulating the acid-alkaline balance in the body. Phosphorus is needed for bone growth, kidney function and cell growth. It also plays a role in maintaining the body's acid-alkaline balance (Fallon and Enig, 2001).

Table 4. Shows the amino acids content of mango seed kernel are demonstrated in Data in this table showed that valine and phenylalanine achieved higher values compared to the FAO/WHO reference (World Health Organization, 1985) followed by therionine, lysine and tyrosine which were somewhat equaled to the reference while arginine and glutamic acids revealed the highest values of all non essential amino acids in mango seed kernel content.

III. NEED FOR DESHELLING MACHINE

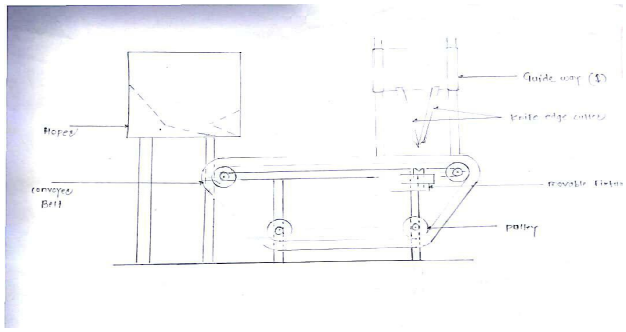
Ripe mangoes are processed into frozen mango products, canned products, dehydrated products, and ready-to-serve beverages (Ramteke and Eipeson, 1997). After consumption or industrial processing of the fruits, considerable amounts of mango seeds are discarded as waste (Table 1.) (Puravankara et al., 2000); they account for 35%–55% of the fruit (Bhalerao et al., 1989), depending on the variety. Actual figures on the quantity of mango waste generated commercially are not readily available. Therefore, the utilization of mango by-products especially mango seed is economical to reduce the problem of waste disposal from mango processing and producction.

A. Properties of mango seed kernel oil

The oil from mango seed is pale yellow in color. The chemical properties of mango seed oil are amongst the most important properties of the oil (Table 6). The index of oil quality is measured by free peroxide values. The low free fatty acid of mango seed oil indicated that the mango seed was almost free from hydrolytic rancidity brought almost by lipases and enables the direct use of such as oil in industries without further neutralization as described by Arogba (1997).

Due to low peroxide level mango seed has high quality. The amount of unsaturation contained in oil is represented by iodine content. The iodine number ranged from 39 to 53. Saponification value represents the average molecular weight (or chain length) of all the fatty acids. Unsaponifiable matter is component of an oily mixture which fails to form soap when blended with NaOH. Unsaponifiable matter of vegetable oils including tocopherols, sterols and squalene is of great importance for oil characteristics and stability as their composition is important (Sim et al., 1972).Figures and Tables.

IV. DESIGN OF MACHINE



The said machine has a sharp v shaped tool which pierces the mango seed and splits the outer shell. The tool has a 10 degree tip angle with total vertical length 150mm. This tool is mounted on a tool post of length 108 mm made of steel to provide rigidity and sustain the impacts. The tool post is provided with a rotor in between tool blades for split motion of tool. This rotor is connected to servo motor which applies the force on tool blades.

The conveyor chain is specifically designed considering the various sizes and shapes of the mango seeds. This conveyor is mounted on the sprockets. The tool, tool post and conveyor move synchronously to deshell the mango seed.

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