

Comparative evaluation of different types of turmeric polisher

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■ **ABSTRACT** : Polishing of turmeric in the Sangli (M.S.) district was practiced with different types of polishing machine (polisher). Most of these were operated by different engine such as diesel engine, tractor and electric motor. The majority of them have been developed by the farmers themselves and being used for polishing on custom hiring. The charging and discharging time, rate of polishing and machine output of tractor operated polishing machine was higher than diesel engine operated polishing machine and electric motor operated polishing machine, respectively. The diesel engine operated polishing machine required more energy than tractor operated and electric motor operated polishing machine, respectively. The cost of polishing by diesel engine operated machine was higher than tractor operated and electric motor operated polishing machine, respectively. Overall the performances of tractor operated polishing machine were satisfactory and accepted for application of polishing.

■ **KEY WORDS** : Turmeric, Polisher, Machine output, Energy requirement

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Turmeric is one of the most imperative and ancient crop spices found in major part of India has very good commercial value for spices oils and oleoresin. The botanical name of turmeric is *Curcuma longa* (Linn.) belongs to family Zingiberaceae. Turmeric is also called as "Indian saffron". It used daily extensively by all classes of people for the preparation of tasty curried dishes. Turmeric not only adds its typical flavour but also, thereby helping to bring out best in curries. India accounts for about 80 per cent of world turmeric production. In excess of 1,50,000 tones of cured turmeric is produced annually, of which 92-95 per cent is consumed with in the country and reaming 5-8 per cent was exported. It basically found in a tropical herb and can be grown on different types of soil under irrigated and rainfall conditions (Nair *et al.*, 1982).

The processing of turmeric consists of three stages *i.e.* curing, drying, and polishing. Dried turmeric has a rough appearance and dull surface colour. The outer

surface can be polished to give a better finish. Polishing removes the surface roughness by getting rid of the surface scales, the small rootlets, and any remaining soil particles. Polishing is done either by manual or mechanical means. Manual polishing consists of rubbing the dried turmeric on a hard surface or trampling them under feet wrapped with gunny bags. Shaking the rhizomes with stones in a gunny bag or bamboo basket is also practiced. Mechanical polishing is carried out in polishing drums. These are very simple drums rotated by hand or by power. The drum is made of expanded metal mesh fixed to solid, circular end plates and is mounted on a central axis. A door is provided for charging and discharging. The drum is covered with a tight wrapping of woven wire, the mesh of which is small enough to retain the turmeric, but large enough to allow dust, dirt, and rootlets to fall through. When the drum filled with turmeric is rotated, polishing is effected by abrasion of the surface against the mesh as well as by rubbing rhizomes against each other as

they roll inside the drum (Narayanan *et al.*, 1982; Philip and Sethumadhavan, 1982; Sikka *et al.*, 1982 and Arora *et al.*, 2007). Sprinkling turmeric water during polishing is said to improve the colour (CSIR, 1950) in manually operated drums.

The polishing of turmeric in the Sangli (M.S.) district was practiced with different capacity machine operated with diesel engine, tractor and electric motor. Most of these machines have been developed by the farmers themselves and being used for polishing on custom hiring basis in the season. There was no any data available on performances of machines. Therefore, the farmer was felt to take a decision on selection of machine, cost of polishing, ease of operation etc. the generated data would help the polisher manufacturer to fabricate the effective and economical operating machines. So, there was no work has been done in this direction hence, the study was undertaken with objective, comparative evaluation of different types of turmeric polishing machines.

METHODOLOGY

The Sangli district has historical background about cultivation of turmeric. The processing of turmeric

consists of three different stages *i.e.* curing, drying and polishing. For these operation farmer uses traditional methods. One of these operations polishing is also most valuable operation because it affects the quality of the product and cost of production of turmeric. Therefore, performance of three different types of polishing machines was carried out in field of farmer.

Selection of machines :

The selection of machine according to the quantity of turmeric to be polished and the rate of polishing with acceptable polishing percentage is very important (Sharma and Aggarwal, 1998). The different parameters on which the performances of machine can be judged are explained as under. In the Sangli district region there were three types of polishing machine used mostly are tractor operated, diesel engine operated and electric motor operated machine. These three different types of machine were selected for the study and their details are given in Table A.

Tractor operated polishing machine :

Tractor operated polisher was driven by tractor

Sr. No.	Particulars	Polariser		
		Diesel operated	Tractor operated	Motor operated
1.	Power (HP)	10	35	2
2.	Type of fuel used	Diesel	Diesel	Electricity
3.	RPM	29	37	34
4.	Overall length of machine (cm)	270	270	160
5.	Overall width of machine (cm)	130	130	100
6.	Overall height of machine (cm)	220	221	118
7.	Length of polishing drum (cm)	165	165	102
8.	Diameter of polishing drum (cm)	140	140	76.2
9.	Shape of polishing drum	Octagonal	Octagonal	Octagonal
10.	Face width of polishing drum (cm)	51	55	27
11.	Provision for exit raw skin of polished turmeric	Perforated holes are provided	No	Window with sieve (10*7 cm ²)
12.	Length of abrasions strip (cm)	160	158	97
13.	Length of shaft of polishing drum (cm)	268	270	135
14.	Polishing drum shaft distance from ground (cm)	150	144	80
15.	Diameter of shaft (cm)	5	6	3
16.	Capacity of drum (qtls)	08	10	2
17.	Arrangement for charging and discharging	Wooden plank with nut and bolts	Wooden plank with nut and bolts	Wooden plank with nut and bolts
18.	Material used for construction of drum	Wood and iron frame	Wood and iron frame	Wood and iron frame

PTO power. The belt pulley arrangement was provided for transmission of power. A 35 HP Taffe tractor was utilized to operate the machine. The polisher was provided with two wheel trolley to enable transportation of machine from one field to another (Pal *et al.*, 2008). The machine was having octagonal shaped polishing drum. The details of this machine are given in Table A.

Diesel operated polishing machine :

It was comparatively small machine operated by 5 HP diesel engine. It was mounted on small trolley to transport by a pair of bullock from one field to another. The details of this machine are given in Table A.

Electric motor operated polishing machine :

This machine consisted of rigid tool frame in which the polishing machine was set up. The tool frame consisted of a frame to accommodate electric motor along with belt and pulley and arrangement. The details of this machine are given in Table A.

Performance parameters :

All the selected machines were evaluated for performances on the basis of different performances parameter are explained below.

Polish percentage :

The mass of turmeric lost in the polishing from an input quantity was taken as polishing percentage and was calculated as :

$$\text{Polish percentage} = \frac{W_r - W_p}{W_r} \times 100$$

where,

W_r = Weight of raw turmeric, kg. and

W_p = Weight of polished turmeric, kg.

Rate of polishing :

The mass of polished turmeric received by the machine in unit time was taken as rate of polishing :

$$\text{Rate of polishing} = \frac{W_p}{t}$$

where,

t = time required for polishing.

Feed capacity per batch :

The measured quantity of turmeric was loaded in the polishing drum up to $\frac{3}{4}$ of full capacity of polishing

drum and noted as feed capacity of the batch.

Machine output :

The quantity of polished turmeric received in total time including charging, polishing and discharging time was noted as machine output and calculated as :

$$\text{Machine output} = \frac{W_p}{t_p + t_L + t_{UL}} = \frac{W_p}{W_T}$$

where,

W_T = Total time of polishing ($t_p + t_L + t_{UL}$).

t_p = Total time of polishing, hr

t_L = Total time of charging raw turmeric, hr.

t_{UL} = Total time of discharging polished turmeric, hr.

Fuel consumption measurement :

Fuel consumed by the machine throughout field operation was measured using the auxiliary fuel supply system tank. The calibration of an auxiliary fuel supply system was done by before installing it. It was made up of M.S. flat sheet. To know the level of fuel in the fuel tank the provision of transparent measuring cylinder was provided at the one side of fuel tank. The fuel consumption was recorded by referring the calibration curve.

Energy requirement :

Energy requirement of tractor and diesel engine to operate the machine was calculated from the fuel consumption in a given time. Considering calorific value of diesel fuel as 10500 kcal/kg and specific gravity of 0.84, energy requirement was calculated as :

$$E = \frac{F \times 0.84 \times 10500}{\text{Machine output} \times 860}$$

where,

E = energy requirement, kW h/kg,

F = fuel consumption per unit time, lt. and.

Where an energy requirement of an electric motor operating a polishing machine was calculated from the electricity consumption in a given time as :

$$E = \frac{\text{Energy units consumed}}{\text{Machine output}}$$

where,

E = Energy requirement in kW h/kg.

F = Fuel consumption lt./hr.

Charging and discharging time :

The time required for the charging the unpolished

raw turmeric in the machine and for discharging of polished turmeric from the machines was measured by stopwatch from the instant of the bags was picked up for charging up to desired level and from the instant the drum started discharging to the instant it became empty.

Speed of polishing :

For determination of speed of polishing drum pointer was fixed on the drum and a reference point on the frame was marked. The no. of revolution per minute was noted by counting revolutions of drum manually in a period of 1 min and the speed was calculated from the observations.

Operating cost of polisher :

Cost of operation was determined by the ratio of total cost (sum of the labour cost and fuel cost) to the amount of polished turmeric. The cost of diesel was assumed to be Rs. 55 per/lt. and the cost of domestic electricity was assumed to be Rs. 3.5 per unit. The labour hiring charges were taken as 125 Rs./day for eight working hours :

$$\text{Cost of operation} = \frac{\text{Total cost (Labour cost + Fuel cost)}}{\text{Quantity of polished turmeric}}$$

$$\text{Total cost} = \text{Cost of labour} + \text{cost of fuel}$$

■ RESULTS AND DISCUSSION

All the polishing machines were operated to get the

polishing percentage 15 to 20 per cent. All the parameters were calculated by keeping this polishing percentage in view. Different observations taken before, during and after the operation of each machine are given in the Table 1.

Rate of polishing :

The total time required to polish a measured quantity of raw turmeric fed in every batch was noted and rate of polishing was determined. Maximum rate of polishing was observed with tractor operated polishing machine followed by diesel engine operated and electric motor operated polishing machine. It might be due to the more abrasion among the turmeric rhizomes, more capacity per batch, the size of tractor operated polishing machine followed by diesel engine and electric operated machine.

Machine output :

The total weight of polished turmeric considering total time (charging + discharging + polishing) was taken as machine output. The machine output was greater with tractor operated machine followed by diesel engine operated and electric motor operated machine. Also, it was observed that, the machine output of tractor operated polisher machine was 9.34 per cent and 68.72 per cent than diesel operated and electrical motor operated machine, respectively. This may be due to the more time required for charging and discharging rather than polishing time.

Table 1 : Average value of different parameters with different machines

Sr. No.	Particulars	Polisher operated by		
		Diesel engine	Tractor	Motor
1.	Number of persons	4	4	2
2.	Charging time (min.)	10.89	19	3
3.	Time required for polishing (min.)	40	40	40
4.	Discharging time (min.)	11.47	14	5
5.	Total time per batch (min.)	62.33	73	48
6.	RPM of drum (RPM)	29	37	31
7.	Final weight of polished turmeric (kg)	467.66	603	124
8.	Weight in one batch (kg)	511	740	150
9.	Fuel consumed on unloaded (l)	0.60	0.72	–
10.	Fuel consumed on load (l)	1.06	1.2	–
11.	Polishing percentage (%)	15.09	18.51	17.33
12.	Rate of polishing (kg/hr)	700.5	904.5	186
13.	Machine output (kg/hr)	449.32	495.61	155
14.	Energy requirement (KW hr/kg)	0.024	0.020	0.009
15.	Cost of polishing (Rs./kg)	0.29	0.26	0.17

Energy requirement :

Maximum energy requirement was found with diesel engine operated polishing machine followed by tractor operated and electric motor operated polishing machine. The diesel engine operated polishing machine required 20 per cent and 166 per cent more energy than tractor operated and electric motor operated polishing machine, respectively. More energy requirement for diesel engine and tractor operated polishing machines was mainly due to use of diesel for operating machines having more cost than for electric motor with lesser cost of electricity. Among diesel engine operated and tractor operated machines more energy required by diesel engine operated polishing machine due to less rate of polishing than tractor operated polishing machine.

Operating cost :

The cost of polishing by diesel engine operated machine was 11.53 per cent and 70.58 per cent more than tractor operated and electric motor operated polishing machine, respectively. The reason for higher cost of polishing by diesel engine operated machine was same as explained in energy requirement. Varshney *et al.*, 2004 have also worked on the post harvest technology of turmeric and the results are more or less similar to the present investigation.

Conclusion :

- The rate of polishing of tractor operated polishing machine was 22.55 and 79.43 per cent higher than diesel engine operated polishing machine and electric motor operated polishing machine, respectively.
- The machine output of tractor operated polisher machine was 9.34 per cent and 68.72 per cent than diesel operated and electrical motor operated machine, respectively.
- Charging and discharging time was more with tractor operated polishing machine followed by diesel engine operated polishing machine and electric motor operated polishing machine.
- The diesel engine operated polishing machine required 20 per cent and 166 per cent more

energy than tractor operated and electric motor operated polishing machine, respectively.

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