



Economics of Conventional and Mechanical Methods of Compaction and Bagging of Dried Chillies

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ABSTRACT

Packaging is an important function for every produce and so is in marketing of Chillies. Good packaging of chilli not only facilitates convenience in transportation and storage but also attracts consumer to pay more. Packaging reduces the marketing cost and protects the quality. In Andhra Pradesh, dried chillies are usually compacted by foot for packing in gunny bags. It was found that there is no uniformity in the packing size of chillies in the country. Packing material used and the capacity of packages are different in different states. The capacity of gunny bags is generally 20-25 kg in North Eastern States and in Punjab. In Andhra Pradesh and Tamil Nadu, the pack size is more than 40 kg. Generally, all the farmers use old gunny bags to pack chillies before selling. Only the exporters repack them in new gunny bags sometimes with polythene liners inside. Conventional method of dried chilli compaction and bagging is normally done by farm labourers, with one person continuously trampling the dried chillies. Conventional method involved drudgery and gives burning sensation to the labourers. The productivity of the conventional method by employing three labourers is 8 bags/h. A unit has been designed and developed at Post Harvest Technology Centre, Bapatla for Mechanical Compaction and Bagging of dried chillies. The capacity of the unit has been evaluated as 20 bags/h. The time of operation was found to be 10-11 min and 3-3.5 min using conventional method and machine respectively. The cost of operation of conventional and mechanized compaction and bagging worked out to be Rs. 30 per bag and Rs. 18.28 per bag respectively. The productivity of the machine in compacting and bagging was calculated to be 150 % and a saving of Rs. 11.70 per bag over conventional method. The mechanical compaction and bagging unit is very much useful for bagging of dried chillies.

Key words : *Dry chillies, conventional compaction, mechanical compaction and bagging*

Chillies are pungent fruits of *capsicum annum* L and *capsicum frutescens* majorly used as condiment or culinary for its pungency, spicy taste, besides the appealing colour it adds to the food. It is used in pickles, sauces, ketchup, essences, oleoresins and it is an inevitable ingredient in Indian dishes. The major producers in the world are India, China, Pakistan, Morocco, Mexico, Turkey and Bangladesh. Chillies are grown in all regions of India. The major Producers are Andhra Pradesh and Telangana contributing 2/3rd of India's production. Andhra Pradesh alone has a production of 8.83 lakh MT from 2.06 lakh hectares, which accounts for 24 percent of area and 47 percent of production in the country (www.indiastat.com, 2016-17 statistics). In Andhra Pradesh, major production catchment include Guntur, Prakasham, Krishna and Kurnool. About 65% of the total chillies produced in India are traded from six major markets, Guntur in Andhra Pradesh, Warangal, and Khammam in Telangana; Raichur and Bellary in Karnataka, and Jalgoan in Maharashtra and even exported to Srilanka, Bangladesh, Malaysia, USA, Nepal, Indonesia, UAE, Italy from these markets (Prabhavathi et al., 2013).

Packaging is an important function for every produce and so is in marketing of Chilli. It is a practice to protect the produce from any damage during storage,

transportation and other marketing aspects. It is required at every stage of marketing from the producer to the consumer. In recent years, packaging plays an important role in marketing of produce. Good packaging of chilli not only facilitates convenience in transportation and storage but also attracts consumer to pay more. The packaging reduces the marketing cost and protects the quality.

In Andhra Pradesh, dried chillies are usually packed in gunny bags. It is found that there is no uniformity in the packing size of chillies in the country. Packing material used and the capacity of packages are different in different states. The capacity of gunny bags is generally 20-25 kg in North Eastern States and in Punjab (Rajendra, 2010). In Andhra Pradesh and Tamil Nadu, the pack size is more than 40 kg. Generally all the farmers use old gunny bags to pack chillies before selling. Only the exporters repack them new gunny bags sometimes with inside polythene liners.

Dried chillies, being low bulk material occupies large volume, need to be compacted before it is bagged to gunny bags. Conventionally, dried chillies are compacted by labour in the field itself by tying gunny bag to a tripod stand and simultaneous filling of dried chillies and trampling by feet till overall weight of the bag reaches 40-45 kg. Conventional method is highly labour intensive involves drudgery, low productive (3

labourers can compact and bag 8 bags per hour) and causes burning sensation to the labour trampling the chillies in bag. In order to avoid drudgery, AICRP on Post Harvest Engineering & Technology, Bapatla has developed a ANGRAU Mechanical Dried chillies compaction cum bagging unit. Technical and economical evaluation of the developed machine was carried out to determine its feasibility for commercialization.

MATERIAL AND METHODS

The study was conducted at farmers field in Kaza and Prathipadu villages of Guntur district in three replications. The variety grown was Indam 5. Generally, gunny bags used for bagging dried chillies have a diameter of 480 ± 20 mm and a length of 1100 mm. Initially, loose bulk density before bagging and compacted density after bagging were determined. (Kaleemullah and Kailappan, 2003)

Developed mechanical compaction cum bagging machine was used for compaction and bagging of dried chillies in three replications. Each replication was spanned about two hours. Time for each bag for compaction, capacity of machine per hour, breakage of pods during compaction and economics of compaction and bagging using machine and was compared with conventional method of trampling and bagging.

RESULTS AND DISCUSSION

A special bamboo tripod stand is formed and erected in the yards and gunny bag was held in between and a person tramples the pods by standing in the gunny bag, to achieve good compaction (Satyanarayana and Sukumaran, 2002)(Figure 1). Certain properties of dried chillies before and after compaction and bagging was presented in Table 1. The data indicated that loose bulk density of the dried chillies was low and after compaction, the bulk density increased from 91 to 223 kg/m^3 .

Table 1: Certain properties of dried chillies during conventional bagging

Parameter	Before compaction and packing	After compaction and packing
Weight (kg)	20.1 \pm 2.2	39 \pm 2.2
Bulk density (kg/m^3)	91 \pm 14	223 \pm 16
Moisture content (%w.b.)	12.35 \pm 0.25	12.35 \pm 0.25



Figure 1. Conventional compaction and bagging of dried chillies

The major components of dried chilli compaction cum bagging machine are

- Main cylinder:** It is the important component of the machine. It develops pushing or pulling force to carry out desired operation using pressurized hydraulic fluid. For the compaction cum bagging machine, a double action cylinder is used which can take power stroke in forward as well as reverse direction. Both forward and reverse stroke was achieved by pumping oil under controlled pressure and flow direction from both oil port of cylinder.
- Moving platen:** It is a steel fabricated structure located between main hydraulic cylinder and pressing work place. It is attached to the ram of cylinder and guided by side columns. Moving platen exerts force on the job placed on pressing work place.
- Guides :** These are provided to ensure perfect parallel and vibration free movement of moving platen. Guides may be round or flat depending upon use and type of columns
- Power pack unit:** It is the most important part of the compaction cum bagging machine. It pumps the oil under control pressure and flow into the cylinder to impart desired speed and develop desired force. Power pack consists of pump, hydraulic valve, oil tank, cooler and hydraulic accessories, manifold block and piping. Hydraulic pump may be driven either by electric motor or IC engine.
- Manifold block and hydraulic piping:** Manifold block include hydraulic valves having number of oil ports viz., suction port, delivery port, return line (tank line) port and drain line port and pilot line port, oil port (A) for forward motion of cylinder and oil port (B) for return motion of cylinder. All these ports are interconnected with each other as well as with oil tank and hydraulic cylinder in correct manner

and sequence for operation and motion of press. To reduce extensive piping, leakage and maintenance, hydraulic valves are mounted on a solid metal block and their oil ports are interconnected by drilling holes in metal block called manifold block

- f. Ram: It is a round bar attached to piston at one end and to moving platen at other end and it moves in and out from cylinder for pushing and pulling operation.
- g. Control panel: it controls overall operation and performance of compaction cum bagging machine by controlling power pack unit. It consists of motor starter, push button, contactor and timer. Control panel gets it feedback from the hydraulic compaction machine by means of limit switch and pressure switch.

The technical specifications of mechanical bagging cum compaction machine was presented in Table 2.

Table 2. Technical specifications of mechanical bagging cum compaction machine

Description	Specification
Type	Hydraulic double acting cylinder compaction machine
Stroke length	1 m
Compaction pressure	1000 kPa
Maximum pressure	2000 kPa
Cylinder diameter	110 mm
Piston diameter	40 mm
Moving platen	360 X 360 mm
Power pack unit hydraulic oil capacity	20 L
Dimensions	965 X 920 X 2850 mm (L X W X H)
Capacity of hopper	7 kg
Power	2 HP single phase

The details of the evaluation of mechanical dried chillies compaction machine was shown in Table 3. Time required for compaction and bagging of dried chillies was recorded to vary from 3 to 3.5 min where as in conventional method, time required varied from 10-11 min. Average bulk density of chillies compacted in mechanical system was noted as 239.4 kg/m³ and average compacted weight of chillies was recorded as 42 kg. The capacity of mechanized compaction and bagging unit worked out to be 20 bags/h.

Table 3. Evaluation of mechanical dried chillies compaction machine

Parameter	Mechanical compaction cum bagging method
Time for compaction and bagging per bag (min)	3.0-3.5
Capacity (bags/h)	20±1
Breakage of pods	Nil
Weight of the bag	42.0±2.2
Bulk density	239.4±7.2

Table 4 depicted the economic analysis of conventional and mechanized compaction cum bagging of dried chillies. It was observed the cost of compaction and bagging in conventional system was Rs. 30/ bag of 40-45 kg where as in mechanized system; the cost of compaction and bagging was worked out to be Rs.18.28 per bag. There was a saving of Rs.11.7 per bag in mechanized compaction and bagging. Total savings in a day of 10 h of working, was estimated to be Rs.2343. Further, productivity in mechanized system was worked out to be 150% over conventional system. Economical analysis suggested that return on investment was worked out to be 70.3% with a payback period of 1.42 years.



Figure 2. Mechanical dried chillies compaction and bagging machine

Table 4. Economic analysis of conventional and mechanized compaction cum bagging of dried chillies

	Assumptions and cost/ benefits	Technology (equipment/ process developed)	Conventional technology
	Cost of the Machine : Rs. 1,50,000		
A.	Assumptions		
i)	Capacity	20 bags/h	8 bags/h
ii)	Life or degeneracy period (in years)	10 years	
iii)	Annual use (days)	45 days	
	(Hours of hiring to be shown separately per day)	10 hours	
iv)	Salvage value	10%	
v)	Interest rate	12%	
vi)	Labour charges (Rs./h or day)	500 per day	
vii)	Labour requirement	2 per day	
viii)	Cost of fuel (Rs./l)		
ix)	Cost of electricity (Rs./unit)	6 kwh	
B	Fixed cost		
i)	Depreciation on all machinery per day	333.33 per day	
ii)	Interest on fixed capital	400 per day	
iii)	Repair and maintenance	333.33 per day	
	Sub total (B)	1066.6 per day	
C	Variable cost		
i)	Cost of raw material	0	0
ii)	Fuel and electricity charges (Rs.)	90 per day	
iii)	Labour charges	1000 per day	0 per day
iv)	Other expenses	1500 Loading, unloading and transportation	
	Sub total (C)	2590 per day	0 per day
D	Total cost (B+C)	3656.6 per day	0 per day
E	cost of packaging	18.28 per bag	30 per bag
F	Profit		
G	Savings over	11.7 per bag	
H	Productivity	200 per day	80 per day
I	Saving per day	2343.3 per day	
J	Increase in productivity	150%	
	Economic analysis		
K	Net Profits per year (Rs.)	105450	
L	Return on Investment (ROI)	70.30%	
M	Pay-back period	1.42 years or 519.20	

CONCLUSION

Conventional method of compaction and bagging of dried chillies is low productive and involves drudgery and burning and day long scorching sensation to the labourers involved. An attempt was made by AICRP on Post Harvest Engineering and Technology, Bapatla to develop a mechanical compaction and bagging unit for dried chillies as a part of a value chain on chillies processing. Developed machine is technically feasible and economically viable. There is a saving of Rs.11.70 per bag in mechanized compaction and bagging process.

LITERATURE CITED

Kaleemullah S and Kailappan R 2003 Geometric and morphological properties of chillies. International Journal of Food Properties. Vol 6(3), 481-498.

Prabhavathi Y, Krishna Kishore N T and Seema 2013 Analysis of supply chain of Spices in India: A case study. International Journal of Scientific and Research Publications, Volume 3, Issue 9, 1-4.

Rajendra Karpate R 2010 Post harvest profile of chilli. Published by Directorate of marketing and Inspection, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Satyanarayana Ch V V and Sukumaran C R 2002 Post harvest profile of chillies. Technical bulletin published by AICRP on Post Harvest Technology, Bapatla.

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