

Evaluation of integrated grading pulverization unit for PKV chilli seed extractor

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Abstract

The variety of chilli used for testing the chilli seed extractor coupled with grader was Jayanti. The physical characteristics of chilli are shown in Table 1.2. The bulk density of chillies was 0.074 gm/cm³. Weight of 1000 chillies was 656.20 g. The husk content, seed content and peduncle content was 57.85, 35.09 and 7.06 per cent. The moisture content was 9.00 per cent and colour was dark red.

The test results of the chilli seed extractor coupled to seed grader using chillies of variety Jayanti provided by Highway Block of Dr. P.D.K.V., Akola are shown in Table 1.3. The sample size was 100 kg chilli fruits and replicated five times. The total seed coming from both the seed outlet was 39.94 per cent. Husk from husk outlet was 60.03 per cent through which 0.32 per cent seed loss was observed. The material collected from cyclone was 4.43 per cent through which the seed loss was observed to be 0.15 per cent. Out of the total seed falling on the grader unit (sieve unit) the upper sieve separated the oversize material such as peduncle, husk pieces, etc. to the tune of 3.20 per cent in which very low seed content was observed to the tune of 0.072 per cent. The lower sieve separated 88.63 per cent seed in which the husk content was 1.98 per cent and broken peduncles were 0.45 per cent.

Keywords: Husk content; Bulk density, Grader unit; Sieve

Introduction

Chilli fruits used in daily diet is grown on 810400 ha in India with the annual production of 747900 tonne (Anon. 1996) out of which Maharashtra state produces 68400 tonne. For planting chilli seedling on this area about 1400 tonne seed is required every year. About 3500 chilli fruits are required to break for obtaining this seed. Farmers take out the seed by hammering chilli fruits with a wooden stick, separating the husk manually using hand separator. This method is tedious mainly due to inhalation of fine particles of chilli fruits. Its pungency results in continuous sneezing and irritation of labour's body. Many a times, it is difficult to get labour for this operation. The problem becomes severe on large scale i.e. seed processing plants, seed companies, etc. moreover the existing method has low output and efficiency.

Material and Methods

Considering the breakage requirement of dry red chilli fruits a chilli seed extractor is fabricated consisting of drum with spikes enclosed inside the casing and the spike are arranged in such a way that, when rotated, each spike on drum passes between the two spikes on the stationary belt. This arrangement enables to break all the chilli fruits entering the casing. The screen is provided to separate the seed from chilli fruits below the drum itself to minimize the further seed handling. The seed is separated through the output provided to the crushing drum. In the concave, the arrangement is made to shift the cut pieces of chilli fruits into screw conveyor through the closed duct for further separation in rotary perforated sieve. The broken pieces of chilli fruits are conveyed axially to the circular screen as well as stirred through screw conveyor resulting in better separation. Output of screw conveyor opens in the rotary perforated sieve enclosed in concentric cylinder where remaining separation of seed is carried out. Here two outlets are provided one for seed and other for husk. An elevator is fabricated with hopper provided at the down end of the elevator, receiving seed from both the seed outlets (Crushing drum seed outlet and concentric cylinder seed outlet) and conveying to the grading unit. The trapezoidal shaped seed cups are fitted on canvas belt which moves on two rollers by providing power to one of the roller. Fourteen cups are incorporated at the spacing of 200 mm on canvas belt and the velocity of the belt is adjusted to 0.42 m/s in order to match with the 50-70 kg/h feeding rate of seed. The arrangement of aspiration is provided at the outlet of the seed elevator for separation of small husk pieces from seed. The seed grading unit is fabricated provided with four point suspension system resting on main frame with reciprocating motion. Two easily removable sieves (scalper and grader sieve) are provided in this unit which reciprocates to and fro with a specific eccentricity (stroke length 12.6 mm), and frequency (380 oscillations/min).

The specification and operating parameters of chilli seed extractor coupled with grader are shown in Table 1.1. The chilli seed extractor coupled with grader was tested by using 100 kg sample size and replicated five times. Before testing the physical characteristics such as, bulk density, 1000 chilli weight, seed, moisture content and colour were determined.

The variety used was Jayanti. The seed extractability and grading efficiency was calculated. Cleaning efficiency was calculated as suggested by the Bureau of Indian Standard (BIS) as given below (IS 5817 : 1980).

$$E (E-G) (E - F) (I - G)$$

Cleaning efficiency = -----

$$F (E - G)^2 (I-F)$$

Where,

E = Fraction of clean seed at clean seed outlet

F = Fraction of clean seed in feed

and G = Fraction of clean seed at foreign matter outlet

The germination of mechanically extracted seed was also determined.

The byproduct of the seed industry i.e. husk left during the seed extraction can be a raw material for oleoresin industry or red chilli powder making cottage industry. Accordingly, in order to utilize the byproduct (husk and low grade seed) the pulverizer was used for making powder of whole chilli fruits and also for making powder for byproducts i.e. husk and low grade seed (approx. 10 : 0.7) with respect to time taken, fineness modulus, particle size and capsesin content. The sample size was 1 kilogram and replicated thrice.

For further analysis of quality, the vegetable (brinjal and potato mix) and chutney were prepared by using powder of whole chilli fruits, powder prepared from husk and low grade seed mixture and locally available chilli powder of popular brand (Kailash) and nomenclature is given as below.

- A. Vegetables prepared by using chilli powder of whole red dry chilli fruits.
- B. Vegetables prepared by using chilli powder of husk and low grade seed.
- C. Vegetables prepared from by using chilli powder of popular brand Kailash available in market.
- D. Chutney prepared by using chilli powder of whole red dry chilli fruits.
- E. Chutney prepared by using chilli powder of husk and low grade seed.
- F. Chutney prepared by using chilli powder of popular brand 'Kailash' in the market

Same procedure was used for preparation of vegetables and chutnies by using chilli powder as mentioned above in all preparations. The products were organoleptically evaluated by a panel of 10 judges and the scores awarded were computed. The vegetable were analysed for appearance, taste and colour and chutnies were analysed for appearance, taste, colour and texture.

Friedman’s Test :

The products were analysed by using Friedman’s test which is non-parametric test as the data is measured in ordinal scale i.e. 1,2,3...10. The calculations are based on the formula of friedman’s test which is as follows

Null Hypothesis :

There is no significant difference between samples based on ranks

$$F^2 = \frac{12}{np(p+1)} \sum_{j=1}^p C_j^2 - 3n(p+1)$$

Where,

n = no. of referees

p = no. of treatments

C_j = Total of ranks of all referees

If (cal) > (tab) with (p -1) d.f. at chosen level of significance, the null hypothesis is rejected otherwise it is accepted.

Cost analysis:

The cost analysis of PKV chilli seed extractor coupled with grader was worked out.

Results and Discussion

The variety of chilli used for testing the chilli seed extractor coupled with grader was Jayanti. The physical characteristics of chilli are shown in Table 1.2. The bulk density of chillies was 0.074 gm/cm^3 . Weight of 1000 chillies was 656.20 g. The husk content, seed content and peduncle content was 57.85, 35.09 and 7.06 per cent. The moisture content was 9.00 per cent and colour was dark red.

The test results of the chilli seed extractor coupled to seed grader using chillies of variety Jayanti provided by Highway Block of Dr. P.D.K.V., Akola are shown in Table 1.3. The sample size was 100 kg chilli fruits and replicated five times. The total seed coming from both the seed outlet was 39.94 per cent. Husk from husk outlet was 60.03 per cent though which 0.32 per cent seed loss was observed. The material collected from cyclone was 4.43 per cent through which the seed loss was observed to be 0.15 per cent. Out of the total seed falling on the grader unit (sieve unit) the upper sieve separated the oversize material such as peduncle, husk pieces, etc. to the tune of 3.20 per cent in which very low seed content was observed to the tune of 0.072 per cent. The lower sieve separated 88.63 per cent seed in which the husk content was 1.98 per cent and broken peduncles were 0.45 per cent. The bottom pan collected 3.66 per cent material through which low grade seed observed to the tune of 0.15 per cent. the average time required for seed extraction and grading of 100 g chilli fruits was observed to be 55 minutes. The seed extractibility was observed to be 98.71 per cent. Grading efficiency and cleaning efficiency was observed to be 86.20 and 84.40 per cent. The germination of this mechanically extracted seed in all cases was above 70 per cent.

Table 1.4 shows the performance of pulverizer for making powder from whole red chilli fruits and from husk with low grade seed. The time taken for pulverizing 1 kg of whole chilli fruits was 4.4 min and 1 kg of chilli husk with low grade seed was 2.4 min. It clearly indicates that nearly half of the time is required to pulverize same quantity of husk with low grade seed (10 :07) as that of whole chilli fruits. This was because the whole chilli fruits and their intact peduncle occupies more space (lower bulk density than husk) in the hopper of pulverizer and needed frequent stirring in order to avoid the blocking of hopper whereas, as the cut pieces of husk and low grade seed needed no stirring and having higher bulk density than whole chilli fruits, the time taken to pulverize these cut pieces of husk with low grade seed was nearly half than that of whole chilli fruits. Similarly whole fruit (Jayanti) contains seed (35.09%) which requires comparatively more time for pulverization than the husk with low grade seed (10 :07). The average particle size and fineness modulus was near about same in case of powder of both whole chilli fruits and husk with low grade seed. The market chilli powder of a popular brand Kailash is finer than the powder prepared by using the pulverizer.

For further quality analysis vegetables (brinjal and potato mix) were prepared by using powder of whole chilli fruits, powder of husk with low grade seed and market chilli powder. Similarly, chutnies were also prepared by using these chilli powders. The products were organoleptically evaluated by a panel of ten judges. The data were analysed by using non parameteric Friedman's test. The results of the test are presented in Table 1.5. The results indicate that, the products prepared by three different types of chilli powders are highly significant. The mean score of the characteristics is depicted in this table. It shows, the products were highly

acceptable in all the sensory attributes receiving score more than minimum score of five. The results thus indicated that for vegetables more score was received by the products prepared from chilli powder of market followed by chilli powder of husk with low grade seed and chilli powder of whole chilli fruits in case of appearance and colour. The similar results are there in case of chutnies from appearance and colour. In case of taste, the vegetables prepared with chilli powder of market and whole chilli fruits were preferred more than that of vegetables prepared with chilli powder of husk and low grade. In case of chutney the results are similar with respect to taste and texture also. But since all the products prepared with powder of chilli husk with low grade seed received score more than seven i.e. ranking good, it can be concluded that, chilli powder prepared from chilli husk with low grade seed can fetch considerable market price.

The economic analysis (Table 1.6) of chilli seed extractor with grader revealed that, the net annual profit in the order of Rs. 46,120/- can be obtained with BEP 36.66 per cent and cost of operation per quintle is Rs. 96/-. The abstract shown in Table 1.6 reveals that, the process is technically feasible and economically viable with 120 mandays year employment generation. The process is simple and does not require highly technical knowlow.

Conclusion :

- i) The seed extractibility of chilli seed extractor coupled with grader was 98.71 per cent. The grading and cleaning efficiency was observed to be 86.20 and 84.40 per cent respectively.
- ii) The pulverizer can be used successfully for making powder of chilli husk and low grade seed.
- iii) As per the organoleptic testing of products prepared with chilli powder of chilli husk with low grade seed, this powder can fetch better market price.
- iv) The chilli seed extractor with grader can generate 120 mandays rural employment with a period of 0.65 year pay back period and 36.66 per cent break even point with annual net profit of Rs. 46,120/-

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Table 1.1 Specifications of modified chilli seed extractor coupled with grader

Sr.No.	Particulars	Specifications
1.	Over all dimension, mm	
	Length	1420
	Width	2440
	Height	1780
2.	Total weight, kg	413
3.	Type of drive	V belt and pully
4.	Prime mover	
	Type	Eelectric motor
	Power, rpm	2.0
	Speed, rpm	1440
5.	Capacity, kg/h	1440
6.	Concentric sieve size	4.0
7.	Grader unit dimensions, mm	
	Scalper sieve	730 X 455
	Graders sieve	730 X 455
	Length of stroke, mm	12.6
	Frequency of eccentric oscillations/min	
	Sieve size, mm	380
	Scalper (r)	4.00
	Grader (r)	2.10

Table 1. 2. Physical characteristics of chillii (Jayanti)

1.	Bulk density, g/cm ³	0.074
2.	1000 chilli weight, g	656.20
3.	Pedence, per cent	7.06
4.	Husk, per cent	57.85
5.	Seed content, per cent	35.09
6.	Moisture content, per cent	9.00
7.	Colour	Dare Red

Table 1. 3. Test results of chilli seed extractor coupled with chilli seed grader

Particulars	Seed outlet				Husk
	Upper sieve	Lower sieve	Bottom pan	Cyclone outlet	60.03 (0.511)
	3.28 (0.238)	88.63 (0.426)	3.66 (0.342)	4.43 (0.276)	
Seed	0.072 (0.016)	86.20 (0.464)	0.30 (0.067)	0.15 (0.025)	0.32 (0.057)
Pedence	2.149 (0.076)	0.45 (0.14)	0.20 (0.057)	0.10 (0.038)	10.22 (0.724)
Husk	1.06 (0.083)	1.98 (0.267)	3.16 (0.204)	4.18 (0.308)	89.46 (0.675)

Note : Figures in paranthesis represent standard deviation

Average time required for seed extraction : 55

including grading, min

Average grading efficiency, % : 86.20

Average cleaning efficiency, % : 84.40

Average seed extractibility, % : 98.71

Germination, % : above 70

Table 1.4. Performance of pulverizer for making powder from chilli fruits and from husk with low grade seed.

Particulars	Chilli fruits	Husk with low grade seed	Market chilli powder
Time taken, min	4.4 (0.20)	2.4 (0.09)	-
Particle size, mm	0.406 (0.004)	0.411 (0.011)	0.378 (0.012)
Fineness modulus	3.532 (0.035)	3.567 (0.095)	3.302 (0.105)

Note : Figures in paranthesis represent standard deviation

Table 1.5. Mean score of sensory characteristics for vegetables and chutney

Treatments	Characteristics			
	Appearance	Taste	Colour	Texture
A	7.3	8.0	7.6	-
B	7.5	7.8	7.8	-
C	8.0	8.1	8.1	-
X^2_{cal}	1819.4	1892.5	1830.1	-
Sig (%)	Sig.	Sig.	Sig.	-
Chutney				
D	7.5	7.9	7.7	7.5
E	7.6	7.5	7.8	7.4
F	7.9	8.1	7.9	7.6
X^2_{cal}	1752.2	1830.7	1813.4	1675.7
Sig (%)	Sig.	Sig.	Sig.	Sig.

Note : Details of treatments A,B,C,D, E and F are given in Material and methods.

Table 1.6. Cost analysis of chilli seed extractor with grader

1.	Cost of machinery, Rs.	36,000
2.	Cost of operation, Rs./q	96
3.	Annual net profit, Rs.	46,120
4.	Break even point, per cent	36.66
5.	Pay back period, years	0.65
6.	Return on investment, per cent	99.78
7.	Employment generation, mandays/year	120