International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July 2018 www.irjet.net p-ISSN: 2395-0072

Comparison of Economy of "PKV" Dhal Mill to Traditional Dhal Mill

Kaushal Kumar Maurya [1], Mohammad Aalam [2], R. B. Gautam [3]

[1]Dean, Mahamaya College of Agricultural Engineering and Technology,Akbarpur,U.P.,India
[2]Guest faculty, Dept. of Mechanical Engineering, M.C.A.E.T. Akbarpur, U.P.,India
[3]Assistant Professor, Dept. of Food Process Engineering, M.C.A.E.T. Akbarpur, U.P.,India

---

Abstract - Pigeon pea (Varity BAHAR) is an important crop of UTTAR PRADESH in INDIA and is used as pulse. Pigeon pea yield was found about 25 – 30 q/ha. The economic analysis was done by different cost concepts i.e. fixed cost, variable cost, total cost etc., which revealed that the average capital investment in PKV Dhal mil. The cost of milling of pigeon pea by PKV Akola dhal mill was found much cheaper (Rs. 0.87/kg) in comparison with traditional method using stone chakki (Rs. 2.054/kg) which is 2.36 time. So, PKV Akola dhal mill was found cheaper than the traditional method in the rural areas in U.P.

Key Words: Key Economy, Break-even-point, Economics, PKV Dhal mill, fixed cost, Variable cost, Total cost, Pay- back period etc.

1. INTRODUCTION

In India, split of pulses are prepared called as "Dal" or "Dhal" and are used as a food material. Commonly, it is prepared at Dal mills processing unit. Dal milling industry is originated as a house hold process and has been practiced not both as a cottage industry but also as a commercial milling operation.The processing is generally done in two steps, loosening of husk by wet or dry method and dehusking and splitting using suitable machines. The beneficial effects of processing on the nutritive values of food pulses are envisaged in two areas: (a) Improved bio-availability of nutrients and (b) Partial or complete removal of anti-nutritional and toxic compounds. Study of economic performance of pulse processing units like PKV Dal mill in terms of cost is thus very essential for accelerating the growth of agriculture processing industries.(wagh et. Al; 2014)

Grain legume or pulse occupy an important place in the world food and nutrition economy, Present world production estimated to be 50 million metric tones, at an average price of 2000 per metric tones, its total value would amount to be Rs. 100 billion **(CFTRI,2001**). India is the largest producer of pulse in the world as well as producer of large large varity of pulses (**Hasan, 1990**). It produces about 27.65% of the worlds total production during the year 2000-01, India produces 11.72 million tones of pulses 24 million hac. of Land. **(The Hindu Survey of Indian agriculture, 2002).** Pulse processing and milling industry occupies an important place among the agro processing industries in India this industry ranks next only to rice and flour industry with about 10,000 commercial mills in capacity range of 1-50 tonnes /day **(Kurien, 1993)**

Dhal recovery in commercial pigeon pea dhal mills has been reported by **Singh and Jambunathan (1980)** in the range of 68-71 percent. Which indicate the milling lasses to the tune of 29-32 percent. The average dhal yield from household and traditional commercial dehulling methods vary from 68-75%, 10-15% less than theoretical average value of 85% **(Kurien, 1971)**. Successful efforts are to be made to bridge this gap.

In milling of pigeon pea grain for dhal, the basic objective is to remove the hulls and separate the cotyledons with minimum loss to kernel. Husk of pigeon pea grain is strongly attached to the cotyledons through the presence of gum and mucilage. Various treatment have been tried to loosen the gum and mucilage. Different dhal mills have been developed like. PKV Akola Dhal mill, CIAE dhal mill, Pantnagar dhal mill etc. to achieve the better efficiency of dhal milling.

Milling of pigeon pea is difficult because of presence of gum layer between seed coat and cotyledon. Pretreatment helps in loosening layer. Pretreatment, dehusking, splitting are three major processes involved in milling of grain completely. For loosening and removing of husk 3-8 passes are given in commercial dhal mills. This action caused breakage and powdering of precious kernel. **Jain et al. (1994)** analyzed in–plant air samples of dhal mills for their quantity, chemical make-up, particle size and fungal profile. The average concentration of suspended and settelable dust was 0.57gm/m^3 and 0.065 kg/m^3/day. The average particle size of the suspended dust was found to be 3.2μ, while the major portion of the dust was chemically organic in nature. As per gillus and penicillium species were found to be associated with dhal dust.

The PKV Dal mill owners faced major problems like inadequate supply of raw material for processing, inadequate

supply of electricity to run the unit and breakage of sieves while processing, etc. It is observed that, the average capital investment in PKV Dal mill along with its accessories worked out to be Rs. 80780. Average capital investment in PKVDal mill (Rs. /unit) revealed that more than 61 per cent of capital investment was in PKV Dal mill along with its accessories, followed by land and building with drying platform which constituted 30.42 per cent of total capital investment. Further, distributed average capital investment in furniture and fixture, and electrical installation and other charges accounted 3.71 per cent and 4.21 per cent, respectively. The total average capital investment for the PKV Dal mill was worked out to Rs. 131000/ unit. (Wagh et al.;2014).

The study revealed that, the amount of Rs. 33750 was the average capital investment in PKV miniDalmill along with accessories. This contributes 40.49 per cent to the total fixed capital investment. It was further observed that the farmers having PKV mini dal mill was more interested in adopting custom hire practice in order to avoid high investment in storing the raw material Thus Rs. 279.93 was estimated as a net retuned per quintal. However the annual net income from PKV mini Dal mill was estimated to be Rs. 85378 (Shende,2013).

This paper is organized introduction about the dhal mill and some relevant literature, then materials and methods in section two followed by result and discussion in section three and after that conclusion in last section.

2. MATERIALS AND METHODS

Richert et al (1974) used hill grain thresher with carborundum stone for brown and black – eyed cow pea. He recommended a through out put of 90 kg/h to obtain a hulling efficiency of 94 – 96%. **Saxena (1975)** tried a cylinder concave mechanism for milling. He recommended a cylinder speed of 5.59 – 5.99 m/s, entrance clearance of 7mm and exit clearance of 3mm for pea grain to obtain a hulling efficiency of 87.91% at a grain moisture content of 6.68 – 7.90% for milling. **Siripurapu et al. (1980)** used a domestic flour mill for milling. He recommended 29 kg/h feed rate and 6.05mm clearance for pigeon pea grain and obtained a hulling efficiency of 66.1% at 79.3 kg/h through put and 4.99mm clearance.

Sahay and Bisht (1988) recommended the carborundum roller speed of 13.5 – 14.0 m/s for black, green and red grain dhal recovery of 74 – 75%, when the clearance between roller and sieve was maintained 10mm through out the length of cylinder. **Phirke et al. (1992)** conducted a socio economic survey in India which indicated that only 10% - 15% pigeon pea dhal (split pea) required for consumption is processed in villages a mini dhal mill running on1.0hp, single phase electric motor was developed with 4 units, viz. splitting unit, sieve unit, aspirator and polisher in order to obtain polished dhal from pigeon pea grains. By changing sieves, the same unit can be used for other pulses.

In a dhal mill, the efficiency of hulling is calculated on the basis of input and output of the dehusking system. Many investigators have suggested different expressions, for evaluating the performance. **Kuprit (1967)** used two coefficients of hulling (C_n) and coefficient of wholeness of kernel (C_{wk}) as the criterion for evaluation. He defined coefficients as:-

$$C_n = (1-N_1/N_2) \quad (2.1)$$

$$C_{wk} = K/(K+M_b) \quad (2.2)$$ Where,

N_1 = mass of unhulled grains after hulling.

N_2 = mass of unhulled grains before hulling.

K = total yield of whole kernels.

M_b = mass of broken and mealy waste (Powder) produced during process.

Overall performance of the system

$$E = C_n \times C_{wk} \times 100 \quad (2.3)$$

Agrawal (1974) – used keprit's equation to evaluate the overall performance of the soyabean dehuller. He defined the coefficient of hulling (C_n) and coefficient of wholeness of kernel (dhal) (C_{wk}) as

C_n = 1 – mass of traction of unhulled grains. (2.4)
C_{wk} = 1 – mass traction of broken. (2.5)

Overall performance of the Soyabean dehuller was therefore calculated as:

$$E = C_n \times C_{wk} \times 100 \quad (2.6)$$

The economic analysis was done by different cost concepts *i.e.* fixed cost, variable cost, total cost etc.

2.1. ESTIMATION OF COST OF OPERATION OF PKV DHAL MILL:

1) Fixed cost

a) Depreciation: This cost reflects the reduction in value of a machine with use (wear) and time (obsolescence). While actual depreciation would depend on the sale price of the machine after its use, on the basis of different computational

methods depreciation can be estimated. The following formula based on straight line method is recommended.

$$D = (P-S)/L$$

Where,

D = depreciation cost avg. per year

P = purchase cost

S = salvage cost

L = useful life

b) Interest: Annual charges of interest should be calculated on the basis of the actual rate of interest payable. If this information is not available, 12% of average purchase price should be taken. average purchase price shall be calculated by the following formula

$$I = ((P+S)/2)*R/100$$

Where,

I= interest on investment

P=purchase cost

S= salvage value of the machine as 10% of P

R= rate of interest, taken as 12%

c) Insurance and taxes: actual amount paid annually for insurance and annual taxes, if any should be charged. If the information is not available, it may be calculated on the basis of 2% of the average price of machine

d) Housing cost: since in case of PKV Akloa dhal mill no special housing is required therefore it could be installed in any room on rent basis. For a place like Ambedkarnagar housing cost is fixed @ 400/month.

2) Variable cost

a) Electricity cost : since PKV dhal mill runs by electric motor which is given by

$$EC= P*H*U$$

Where,

EC = electricity costs

P = electric power consumed per hour

H = no. of hours for which motor is operated

U = cost of 1 unit of electricity (Rs. 5.90)

b) Repair and maintenance: repair and maintenance expenditure is necessary to keep a machine operable due to wear, part failure renewal of parts and tubes and accidents. The cost of any allowance to which they may be entitled. Average cost per hour may be computed by dividing the total cost by the no. of hours the operator has performed the work. This cost is, of course higher than the average per hour work on the farm because part of the time will be used for traveling, interruptions and this is not paid for directly by the customer.

Labor wages was taken @ Rs. 150 for skilled and @ Rs. 100 for non-skilled per day per labor. Since milling requires unskilled labor hence wages & labor charges is Rs. 100/day for 8 hrs. Results are given in appendix- c

2.2 BREAK EVEN POINT (B.E.P)

When a common variable affects the cost of two methods. The value of variable at which the cost for both method will be equal. This value of variable is known as break even point.

At break even point unit cost of operation of big and small machine will be same.

$$B.E.P. = \frac{\text{Fixed cost (Rs/h)}}{\text{Cost of traditional system (Rs/h)} - \text{Variable cost (Rs/h)}}$$

2.3 Payback period

It is the number of year it would take for an investment to return its original cost through the annual cash revenues it generates, if the net cash revenues are constant each year the pay back period may be calculated from the equation.

$$P = \frac{I}{E}$$

Where,

I = Amount of investment, Rs

E = Expected annual net revenue, Rs

3. RESULT AND DISCUSSION

3.1 ECONOMIC OF PKV AKOLA DHAL MILL

3.1.1 Cost of milling

The cost analysis indicated that based upon fixed and variable cost. The cost of milling was found Rs. 0.87/kg (Appendix - A) where as the cost of milling by traditional method using stone chakki was found Rs. 2.054/kg.

The above observations indicated that the PKV dhal mill is better than the traditional method.

3.1.2 Break even point and pay back period

Annual use at which cost of operation of PKV Akola dhal mill and traditional method (stone chakki) will be same i.e. break even point is found to be 146.31 hr. (Table. 1,Fig.1) and pay back period is found to be 633.44 hrs.(Appendix B).

Table -1: Comparison of cost of milling for B. E. P.

Time of operation (hours/y)	Cost of operation (Rs/kg)	
	Traditional method	PKV Akola dhal mill
10	2.054	21.805
50	2.054	4.845
100	2.054	2.725
150	2.054	2.018
200	2.054	1.665
300	2.054	1.311
400	2.054	1.135
500	2.054	1.029
600	2.054	0.958
700	2.054	0.907
800	2.054	0.87

3. CONCLUSIONS

Pigeon pea (Varity BAHAR) is important crop of U.P. and use as pulse. Pigeon pea yield are about 25 – 30 q/ha. The cost of milling of pigeon pea by PKV Akola dhal mill was found much cheaper (Rs. 0.87/kg) in comparison with traditional method using stone chakki (Rs. 2.054/kg) which is 2.36 time folds. So PKV Akola dhal mill is found more cheaper than the traditional method in the rural areas.

ACKNOWLEDGEMENT

The authors are very thankful to the reviewers for their constructive suggestions by which the quality of the paper is enhance.

REFERENCES

Araullo, E.V. 1974. Processing utilization of cow pea, chick pea, pigeon pea and mung bean. In: Proceeding of an Interdisciplinary symposium held in 1974 on nitration of agriculture with food science. International development research centre, Cnada, PP 131 – 142.

Central Food Technological Research Institute (CFTRI). A brief over view of the grain legume situation (Production Processing, Vitalization and storage): FAO expert consultation on grain legume processing.

Hasan, B. 1990. Constraint in milling, processing and utilization of pulses, lecture, notes, training on operation and management of dhal mills. May 1990, Pant Nagar, India.

Igbedion, S.O., Shair, S. and Aderige, B.J.I. 1995. Effect of processing on total phenoals and proximate composition and climbing bean. J. Food science & Technology 32:497 – 500.

Jain, S.K., Jain, R.K. and Bera, M.B. 1994. Qualitative and quantitative analysis of dust pollution in dhal mill. J. Food Science and Technology 31:55 – 57.

Kumar, Atoll (1982), study of a continuous dehusking for pigeon pea grain. M. Tech. Thesis (Agril. Engg.), G.B. Pant University of Agril. & Tech., Pantnagar.

Kumar, D (1993) Optimization of machine parameters in milling of pigeon pea. M. Tech. (Agril. Engg.). Thesis, G.B. Pant Univ. of Ag. & Tech., Pant Nagar.

Kuprit, Y.N. (1967), Technology of grain processing and provender milling (translated from Russian), Jerusalem, Israel Program for Scientific Translations 555P.

Kurien, P.P. 1968. Pulse milling in India. J. food Sc. and Technology, 56:203 – 207.

Mayande V.M.R.(1987) Pigeon pea milling Technologies, Biochemical & Engg. Studies. M. Tech. (Agril. Engg.). Thesis, G. B. Pant Univ. of Agril. & Tech., Pant Nagar.

Narsimha, H.V. and Desikachar, H.S.R. 1978. Objective methods for studying cookibility of tour pulse and factors effecting varietal differences in cooking. J. food Sc. & Tech. 15: 47 – 50.

Paredes – Lopez, O., Carabez, T.A., Palmer, T.L. and Reyes, M.C. 1991. Influence of soaking salution on cooking quality of common beans. Plant food and human nutrition 41: 155 – 164.

Phirke, P.S., Umbarkar, S.P. and Tapre, A.B. 1992. Development and evaluation of mini dhal mill for villages. Agricultural mechanization in Asia and Latil America 23:62 – 64.

Sahay, K. M. and Bisth, B.S. (1988) optimization of grades of carborundum for best recovery dhal in milling different pulses. XXIII ISAE convention, Allahabad, Agriculture Research Institute Allahabad, India

Saxena, R.P. 1985. Milling of pigeon pea grain and associated aspects. Thesis Ph. D. (Agricultural Engg.) G.B. Pant Univ. of agri. and Tech., Pant Nagar, India.

Singh, U 1984. The inhibition of digestive, enzymes by poly pherals of chick pea and pigeon pea. Nutrition reports International 29: 745 – 753.

Singh, U 1988. Anti nutritional factors of check pea and pigeon pea and their removal by processing. Plant food for human Nutrition 38: 251 – 261.

Singh, U 1995. Methods for dehulling of pulses: A critical appraisal. J. food science & Technology 32: 81 – 93.

Verma, P (1991), enzymatic pretreatment of pigeon pea grain and its Interaction with milling. M. Tech. thesis, G.B. Pant Univ. of Ag. & Tech., Pant Nagar.

BIOGRAPHIES

Dr. K.K. Maurya has completed his masters in Post Harvest Engineering from I.I.T. Kharagpur in 1984 and Ph.D. in Process and Food Engineering from GBPUA&T Pantnagar, Uttrakhand. He has published several research papers in various reputed journals. Presently, he served as a post of Dean in MCAET Ambedkar Nagar.

Mohammad Aalam has completed his B.TECH in Mechanical Engineering from Aligarh Muslim University and M.TECH in Production and Industrial Engineering from Jamia Millia Islamia, New Delhi. He has published several research papers in various reputed journals. Presently, he served as a post of Guest Faculty in Mechanical Engineering Department in MCAET Ambedkar Nagar. His comprise area ISM, TISM, IRP and FUZZY-MICMAC approach for modeling.

Appendix - A

Cost analysis of PKV Akola dhal mill for milling of pigeon pea

Data required:

1. Cost of machine (P) = Rs. 45000/-
2. Useful life (L) = 10 years
3. Salvage cost (S) = 10% of P
4. Interest (I) =12% annually
5. Insurances and taxes=2 annually
6. Shelter = Rs.400/month
7. No. of working days=100/year
8. Working hrs./year (H) = 800
9. No. of labor require=2(unskilled)
10. Laborcost=Rs.100/day (unskilled)
11. Cost of 1 unit of electricity = Rs 5.90.

Cost calculation:

1. Fixed cost

a) Depreciation; = Rs. 4050/year

b) Interest on investment:=Rs. 2927/year

c) Insurances and taxes: = Rs. 900/year

D) Shelter=Rs. 4800/year

Total fixed cost= 4550+2970+900+4800 = Rs. 12720/year = Rs. 15.90/hr.

2. Variable cost

a) Electricity charge =Rs. 8.496/hr.

b) Repair & maintenance=Rs.2250/year = 2.81/hr.

c)Labor cost = Rs. 25/hr.

Total variable cost = 8.496+2.81+25 = Rs. 36.306/hr

Net cost = fixed cost + variable cost

= 15.90 + 36.306 = Rs. 52.20/hour

Optimum feed rate = 60kg/hr

Cost of milling = 52.20/60 = Rs. 0.87/ kg

Cost analysis of milling of pigeon pea by traditional method

Cost of stone chakki used for milling in villages is around Rs.300-400.

1) Fixed cost: since the cost of machine is very low hence the fixed cost of machine can be neglected.

2) Variable cost: (assuming chakki is running for 100days/year & 6 hrs a day)

a) Repair and maintenance: Rs. 0.025/hr. = Rs. 0.004/kg

b) Labour cost: 1 labor is able to process 40 kg of pigeon pea in a day (8hrs) & he charge Rs. 100/day. Hence labour charge for milling

= 100/40 = Rs. 2.5/kg

Total cost: Rs. 0.004+2.5 = Rs. 2.054

APPENDIX – B

Calculation of pay back period

The difference between the cost of milling by PKV Akola dhal mil and by traditional method (X) = 205.4 – 87 = Rs 118.4/q

Hence the amount of pigeon pea to be milled for Pay back (Y)

Y=Cost of Machine/X

=45000/118.4=380.067q

Hence pay back period (P) =Y/ feed rate

=380.067/0.6=633.44 hours