Utilization of Value Added *Prosopis juliflora* Pod Milling Products for Production of Livestock Feeds

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The genus *Prosopis* contain 44 species, is spread over throughout Africa, South America and South and South-east Asia. *P. juliflora* is native to Central and South America, is now spread throughout the arid and semi-arid tropics. It is an exotic to Indian sub continent, was first introduced into India in 1857 from Latin America; in Rajasthan it has been introduced by the ruler of the princely state of Marwar in 1913. It is estimated that at present, this plant inhabits more than 500,000 ha of our country, grows from sandy to saline alkaline soils, although its densities and productivity vary with different areas and habitats. The plant provides timber, fuel, and flowers, which are also consumed by the birds and produce good quality of nectar for honey. Mature *P. juliflora* tree also produce highly palatable and nutritious pods in large quantities. Mature pods, which fall on the ground, are rich in protein and free sugars, gives them a sweet taste are avidly consumed by range foraging domestic as well as wild herbivores. The pod production from whole country is estimated to be million t/year. The ripened pods contains, 6.4% water, 4.2 ash, 12.1% ether extractives, 12.8% crude protein, 71.0% total carbohydrates and 480 kcal% gross energy. Up till now pods have been consumed as such but recently at CAZRI technologies have been developed for processing of *P. juliflora* pods using modified Multi-purpose plot thresher and Full circle Hammer mill by which different value added pod fractions can be obtained. These milling products can be used for production of various animal feed products.

Milling Process: The milling process involves collection of mature pods from the field, dried in the sun (Photo.1), which are then milled either using Modified Multi-purpose Plot Thresher (MPPT) or Full Circle Hammer Mill (FCHM). The multi-purpose plot thresher originally developed at CIAE, Bhopal was modified at CAZRI (Photo. 2). The multi-purpose plot thresher had a capacity to process 60-70 kg pods/hr. Output of the machine in terms of different component of pods were 37-54% endo-carp with seed, 19-31% meso-carp powder, 14-36% epi-carp (fiber), about 1-5% loss in the form of dust including weight loss due to moisture, etc. In the improved version, the blower was kept idle/without power so meso-carp powder can be collected through fine sieves. The rotation/speed of the drum was changed so that most pods get threshed between concave and pegs/beaters. The other components of the machine were also modified; new threshing drum was fabricated with high carbon steel pegs, which was provided with a lateral steel rod at the tip for better scrubbing, concave clearance was adjusted and fixed at 25 mm at feeding, which decreased up to 10 mm at the other end. The Full Circle Hammer Mill (Photo. 3) driven by 7.5 hp electric motor, basically developed for milling of concentrate feeds like, cereal and leguminous seeds, and oil seed cakes, were used for coarse- and fine-milling of the sun dried *P. juliflora* pods.


Photo 1

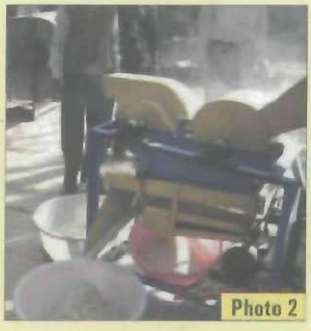
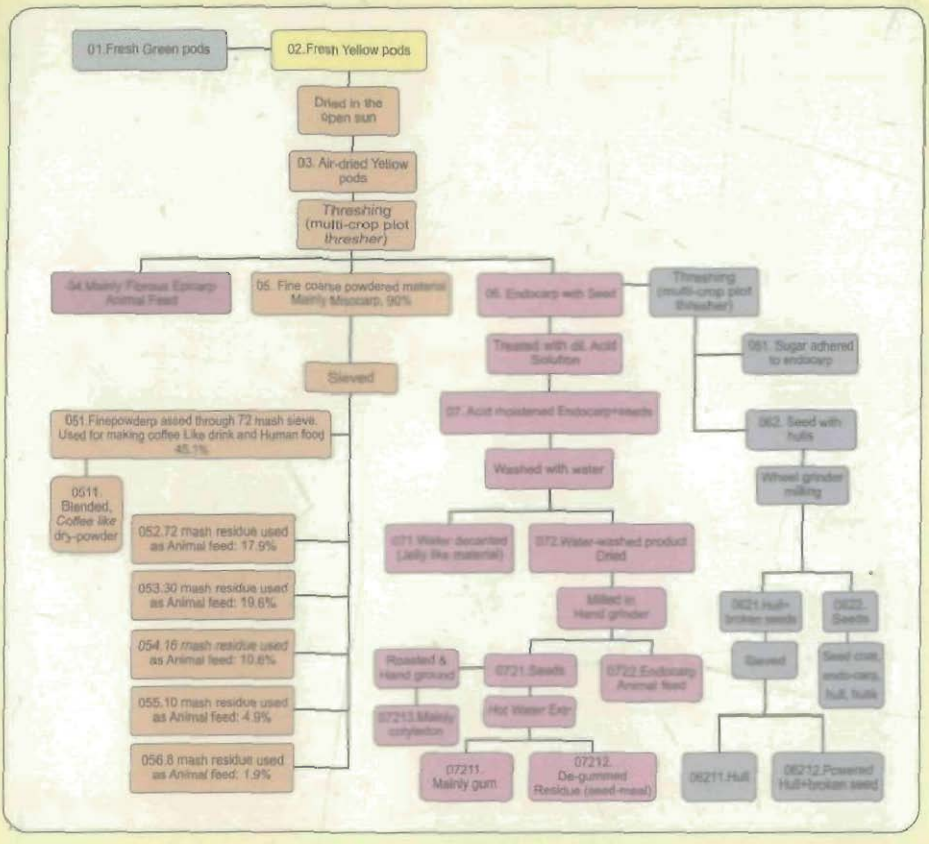


Photo 2


Photo 3

The sun dried whole pods as well as its milling products were analyzed for proximate principals. Out of 25 different pod fractions (Fig 1) separated by MPPT milling, followed by sieving, the 3-products (fibrous epicarp, amorphous mesocarp and fibrous endocarp) were used for production of multi-nutrient feed-blocks (MNB) and multi-nutrient feed mixture (MNM), and of 2-products obtained by FCHM milling, only fines portion was used for production of complete- and supplement-fodder blocks using hydraulic fodder block making machine.

Fig.1. Schematic diagram of processing of *Prosopis juliflora* pods for production of various livestock feed products



Multi-nutrient Feed Blocks: The standard formulation feed blocks are produced by mixing various feed ingredients, viz., molasses, urea, common salt, vitaminized mineral mixture, dolomite, wheat bran, guar meal and guar gum dust (used as a binder), the mixture is then transferred to the iron mould and pressed in screw type hand press. The block is then dried in the solar dryer, which can be offered to the livestock as a lick (Photo. 4). The *P. juliflora* pod milling products (MPs) i.e., fibrous-epicarp (A), -endocarp (B) and amorphous-mesocarp (C) obtained by MPPT milling were tried to use for production of multi-nutrient feed blocks (Photo. 5). The chemical composition of A, B and C milling products (Table 1), and of standard formulation feed-blocks (MNB-S) and those produced by using these milling products have been presented in Table 2. The chemical analysis of the MNB-S and the blocks produced from *P. juliflora* milling-products i.e., MNB-A, MNB-B, and MNB-C (Photo. 6) indicated that moisture and protein content of both the types of blocks was comparable, ash contain was high in MNB-S than MPs, organic matter, ether extractives and total carbohydrates were appreciably high in MPs than MNB-S, which was reflected in higher gross energy levels in MPs than


Photo 4


Photo 5


Photo 6

Table. I. Chemical composition (per cent on dry matter basis) of milling products of *Prosopis juliflora* pods

S. No.	Milling product	Moisture*	Ash	Organic matter	Crude protein	Ether extractives	Total Carbohydrates	Gross energy, kcal
1.	A	6.92	4.7	95.3	7.37	3.52	84.41	425
2.	B	7.08	4.2	95.8	10.70	4.24	80.86	436
3.	C	8.10	6.03	94.0	12.76	9.16	72.05	467

*As such basis.

Table. 2. Composition (%), chemical constitution (per cent on dry matter basis) and physical characteristics of Multi-nutrient feed blocks (MNB) prepared from *Prosopis juliflora* pod milling products

I. Composition					
S. No.	Ingredient	Standard formulation	A	B	C
1.	Molasses	44.5	34.90	35.4	33.7
2.	Urea	4.30	3.3	3.4	3.2
3.	Water	4.0	3.0	3.0	3.0
4.	Common salt	4.30	3.3	3.4	3.2
5.	Dolomite	4.30	3.3	3.4	3.2
6.	Vitamin Min mixture	4.30	3.3	3.4	3.2
7.	Wheat bran	32.10	21.7	20.4	24.3
8.	Milling product	-	25.10 (A)	25.5 (B)	24.3 (C)
9.	Guar meal	5.10	4.0	4.1	3.9
10.	Guar gum dust	1.0	1.0	1.0	1.0
II. Chemical Constitution					
1.	Moisture*	2.7	3.0	2.7	4.0
2.	Ash	21.7	17.4	17.2	15.9
3.	Organic matter	78.3	82.6	82.8	84.1
4.	Crude protein	22.9	20.7	22.2	20.9
5.	Ether extractives	4.1	7.0	6.04	6.0
6.	Total Carbohydrates	51.3	54.8	54.6	57.2
7.	Gross energy, kcal	381	411	409	412
III. Physical Characteristics					
1.	Fresh weight, kg		2.40	2.40	3.40
2.	Final weight, kg		2.22	2.10	3.23
3.	Loss on drying, %		12.7	12.4	5.0
4.	Volume, Cu cm		2457	2071	2792
5.	Bulk density, g/cu cm		0.9	1.02	1.16

*As such basis.

MNB-S. The volume of MNB-A, MNB-B, and MNB-C blocks was 2300, 2500 and 1857 cu cm, and bulk density, 0.97, 1.02 and 1.16 gm/cu cm, respectively. Most of these values were comparable with the MNB-S.

Multi-nutrient Feed-mixture: Similar to multi-nutrient feed block production, the standard formulation multi-nutrient feed mixture (MNM) is prepared by mixing molasses, urea, common salt, vitaminized mineral mixture, dolomite, wheat bran and guar meal. The mixture is then dried in the open sun then it can be offered as a supplement, mash-feed. 3-formulations of multi-nutrient mixture using A, B and C products were developed (Photo. 7). The standard nutrient mixture (MNM-S)

Photo 7

contained 33.3% wheat bran (WB), whereas, the mixture produced from A (MNM-A), B (MNM-B) and C (MNM-C) contained mixtures of 21.7% WB and 25.10% A, 20.4% WB and 25.5% B and MNM-C, respectively. The chemical composition of standard formulation nutrient-mixture and those prepared by using A, B and C products have been presented in Table 3. The chemical analysis of these mixtures revealed that moisture contain in all the mixtures were comparable, but ash content was high in MPs mixtures. The ether extractives of MNM-S and MPs mixtures were comparable but total carbohydrates and gross energy content of MPs mixtures were high, the protein content of MNM-B and MNM-C was also appreciably higher than that of MNM-A and MNM-S mixtures.

Table. 3. Composition (%) and chemical constitution (% on DM basis) of Multi-nutrient mixture (MNM) prepared from *Prosopis juliflora* pod milling products

I. Composition					
S. No.	Ingredient	Standard formulation	MNM-A	MNM-B	MNM-C
1.	Molasses	46.14	38.90	37.0	34.90
2.	Urea	1.06	1.06	1.06	1.06
3.	Water	0.89	1.00	1.00	1.00
4.	Common salt	4.44	3.40	3.6	3.4
5.	Dolomite	4.44	3.40	3.6	3.4
6.	Vitamin Min mixture	4.44	3.40	3.6	3.4
7.	Wheat bran	33.27	22.40	20.80	25.2
8.	Milling product		25.70 (A)	26.70 (B)	25.2 (C)
9.	Guar meal	5.32	4.1	4.3	4.0
II. Chemical Constitution					
1.	Moisture*	3.1	3.1	3.2	3.6
2.	Ash	21.3	18.3	17.3	16.4
3.	Organic matter	78.7	81.7	82.7	83.6
4.	Crude protein	11.6	9.45	13.2	13.8
5.	Ether extractives	4.2	3.7	3.5	4.0
6.	Total Carbohydrates	62.9	68.6	65.9	65.8
7.	Gross energy, kcal	365	372	381	389

*As such basis.

Supplement- and Complete-Fodder Blocks: Two types of milling products, viz., coarse and fine particles can be obtained by milling of *P. juliflora* pods with Full Circle Hammer Mill. The fines (D) portion was tried for production of 2-types, i.e., complete- (CFB) and supplement-fodder blocks (SFB). The composition of coarse and fines (Table 4), and of complete- and supplement-fodder blocks produced (Photo. 8) by using *P. juliflora* pod fines have been presented in Table 5. The complete

Table 4. Chemical composition (% on dry matter basis) of wheat-bran, whole *Prosopis juliflora* pods and its milling products

S. No.	Feed ingredient	Preformed water*	Ash	Organic matter	Crude protein	Ether extractives	Total Carbohydrates	Gross energy, kcal
1.	Wheat-bran	7.5	11.3	89.6	14.3	4.2	70.3	411
2.	*Prosopis juliflora* pods	4.2	6.7	93.3	14.0	4.9	74.5	434
3.	Milling product (coarse)	5.4	6.8	93.2	13.5	2.1	77.7	418
4.	Milling product (fines)	6.3	7.6	92.4	13.9	2.4	76.1	417

*As such basis.

Table 5. Chemical composition (% on dry matter basis) of supplement- and complete-fodder block produced from *Prosopis juliflora* pod milling product (fines)

S. No.	Milling product	Preformed water*	Ash	Organic matter	Crude protein	Ether extractives	Total Carbohydrates	Gross energy, kcal
1.	Supplement block	8.1	9.9	92.4	22.3	2.0	67.9	415
2.	Complete feed block	7.5	8.5	91.7	11.7	1.6	78.3	406

*As such basis.

fodder block (Photo. 9), comprised of 90% D and 10% molasses, and supplement fodder block of 4.9% molasses, 2.0% urea, 1.5% each of vitamin-mineral mixture, common salt and dolomite, 8.2% guar meal, 73.5% D and 4.9% tumba seed cake. CFB and SFB on as such basis contained, 7.5 and 8.1% preformed water, and on dry matter basis contained, 91.7 and 92.4% organic matter, 8.5 and 9.9% ash, 1.6 and 2.0% ether extractives, 11.7 and 22.3% crude protein, 78.3 and 67.9% total carbohydrates and 406 and 415 kcal% gross energy.

Photo 8

Photo 9

Thus value added *P. juliflora* pods milling products (A, B, C and D) obtained by MPPT and MCHM milling can be used for production of various animal feed products like 1. Multi-nutrient feed blocks (3 types), 2. Multi-nutrient feed mixtures (3-types) as well as 3. Complete- and 4. Supplement fodder blocks. Adoption of simple and appropriate feed-product process technologies developed at CAZRI for production of animal feed products using *P. juliflora* milling products not only generate employment in the rural sector but also help to augment livestock productivity in the drought prone areas of our country. The feed products produced from *P. juliflora* milling products are not only cheaper but also nutritionally superior over the standard formulation feed-products.

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