

On farm post harvest handling of aonla in Gujarat state

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ABSTRACT

An extensive survey of 62 aonla orchards with person interview schedule was undertaken to obtain comprehensive information on post harvest handling of aonla fruits followed by farmers in the state of Gujarat. Manual harvesting and collection was followed by 93% of the farmers with lower harvesting capacity (111.20 kg/day/person) and higher harvesting losses (1-6%). Average harvesting losses were found 3.10 %. During whole harvesting season, aonla growers followed 3 to 10 pickings. Very few farmers used the fruit picker for harvesting aonla. Average fruit yield per tree was 84 kg. Manual grading with very low capacity (182 kg /day/person) was followed by aonla farmers. Aonla farmers adopted fruit size as the main grading criteria and categorised the fruits into three grades. About 85 % farmers did gunny bag packaging with an average package size of 40 - 50 kg. Green leaves of trees were used as cushioning material. Farmers dispatch the aonla fruits to the wholesale market in evening with hired and locally available vehicles like loading Rickshaw, *Chhakada*, matador, etc. The produce of the majority of the farmers in Gujarat travelled up to 100 km. The transportation losses were found between 1 and 5 % with an average value of 2.6 %. Storage of aonla fruits was not performed at orchard level. Harvested aonla fruits taken to the wholesale market on the same day or in few cases latest by the next day morning. Harvesting, grading, packaging and transportation are the most problematic and time consuming operations in post harvest handling of aonla fruits at orchard level.

Key words : Aonla, post harvest, orchard

The Aonla (*Embllica officinalis*), or Amla also known as Indian Gooseberry is a minor sub-tropical deciduous tree belonging to the family, *Evphorbiaceae*. Aonla is thought to be a native of India, Ceylon, Malaysia and China (Kalra, 1988). Aonla fruit is very popular for its medicinal property. Fruit is acid, cooling, laxative and diuretic. Dried fruit is useful in hemorrhage, chronic dysentery, diabetes, dyspepsia, cough, anaemia and jaundice (Rawat and Uniyal, 2003). Aonla is one of the richest sources of vitamin C, whose deficiency causes various diseases. The importance of this fruit is also due to its

high (4.45 %) content of tannin i.e. gallotanic acid which on hydrolysis yields gallic acid (Kalra, 1988). Fruits are utilised for a variety of products like preserve (murraba), squash, pickle, dried flakes, candy, jelly, jam, toffees, dried chips, tablets and powder (Kalra, 1988). The magnitude of post harvest losses in this fruit is estimated to be 25-30 percent (Singh, 2000).

Lack of appropriate harvesting, on-farm handling and preservation techniques, improper packaging and transportation system and non-availability of cold chain in the entire post-harvest handling operations are some of the major reasons for higher post harvest losses. At present there is a widespread mismatch between production and post harvest technologies in India (Rajput, 2001). A large

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quantity of fruit goes waste due to poor harvesting and handling practices and inadequate storage facilities. Aonla fruits are highly perishable in nature. The shelf life of aonla fruit is reported to be 6-9 days under ambient condition (Kumar and Nath, 1992). Enhancement of shelf life and an appropriate post harvest handling system is necessary for reducing the losses of this most valuable fruit. In India, the area under aonla cultivation is about 49,620 hectares with an annual production of about 1,50,500 tonnes (Singh, 2003). Aonla cultivation in Gujarat is expanding at faster rate. Area under aonla cultivation in the state is about 7,763 hectares and annual production is about 56,428 tonnes (Annon, 2004). It does not enjoy the same status as the other commercial fruits and vegetables due the low commercial value, high perishability and the non-availability of standard post harvest technologies.

METHODOLOGY

A personal interview schedule was prepared by keeping in view the objectives of the study, which was divided in to maturity indices, harvesting, collection, grading, packaging, transportation, storage, etc. The information cover the complete technical details of the maturity indices, method of harvesting, harvesting efficiencies, harvesting losses, collection method, grading criteria, number of grades, type and size of packaging, cushioning material used, time of transport, type of vehicle, distance travelled, time in transport, transport losses, reason for different losses, method of marketing and other relevant factors. Pre testing of interview schedule was carried out with three selected knowledgeable aonla farmers. On the basis of answers given by these respondents, necessary changes were made.

The aonla is grown in only 18 districts of the state. To simplify the study, the districts having more than 100 ha area under aonla cultivation were only considered for study. These seven districts were under Middle and North Gujarat region. Out of these seven, only first four districts (i.e. two districts representing the Middle Gujarat zone and remaining two representing North Gujarat zone) were selected for field survey purpose. From each selected district, first two

Talukas having greater area under aonla cultivation were selected for field survey. The farmers for survey purpose were selected on the basis of area of orchard, age of plantation and ease in approachability. In each taluka about 4-12 orchards were surveyed. As the study was concerned with understanding the knowledge, most reliable person from each orchard was selected for personal interview and the data were collected of their orchard (62 orchards). The details regarding size of sample & orchards are as under:

Zone	District	Taluka	No. of orchards
Middle Gujarat	Anand	Anand	8
		Borsad	8
	Kheda	Mehmdavad	8
		Nadiad	8
North Gujarat	Gandhinagar	Gandhinagar	12
		Mansa	9
	Mehsana	Mehsana	5
		Vijapur	4
Total	4	8	62

RESULTS AND DISCUSSION

The results are interpreted as per the sequence of post harvest handling channel of aonla fruits followed by the farmers.

1. Harvesting and collection

Maturity indices for harvesting

In middle and north Gujarat regions, 84.37 and 79.99 % growers respectively followed the fruit surface colour brake as the criteria for harvesting (Table 1). About 82.26 % aonla farmers of the state followed the fruit surface colour brake as a harvesting criteria. In north Gujarat region however, 16.66 % growers followed combination of the colour brake and fruit size as characteristics observed for harvesting of aonla. Other characteristics followed were fruit seed colour brake, taste, fruit become segmented and fruit surface skin become thinner.

Table 1 Maturity indices for harvesting of aonla fruits

Characteristics	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Fruit surface colour	87.50	81.25	84.37	76.16	88.88	79.99	82.26
brake							
Fruit seed colour	-	06.25	03.12	-	-	-	01.61
break							
Colour brake+	-	06.25	03.13	19.04	11.11	16.66	09.68
fruit size							
Colour brake + taste	-	06.25	03.13	04.76	-	03.33	03.23
Fruit seg-mented +	12.50	-	06.25	-	-	-	03.23
skin become thinner							

(b) Time of harvesting

About 60 % farmers harvested aonla fruits in morning hours (Table 2). About 65.63 % growers in middle and 53.32 % growers in north Gujarat harvested aonla during morning session only. While, 34.37 % growers in middle and 43.33 % growers in north Gujarat, harvested the aonla fruits during whole day. In case of harvesting in morning hours, the same manpower was used for grading and packaging in afternoon hours. While, in whole day harvesting, right from the morning some labours were kept reserve for grading and packaging.

Harvesting method

Majority of aonla growers (about 94%) followed hand picking method only. They use ladder or high table to pick the fruits from tree (Table 3). Inner side fruits were picked by climbing on the tree itself. The fruits on outer side branches were harvested by climbing on ladder / table. After harvesting of certain fruit load, harvesting person comes down from tree / ladder and dumps the fruits in heap form on the ground at

the centre of the area being harvested. Same method is repeated for whole operation. Some aonla growers collected the fruits on plastic sheet or cotton cloth. Only about 3.25 % growers in both the regions used locally made hand tools 'Ankoli' (fruit picker) which is like a hook made of iron rod for picking of aonla fruit. While another about 6.25 % farmers followed the harvesting of fruit by shaking of the tree branches in middle Gujarat region only. Afterwards these fruits are collected manually from the ground.

Number of fruit Pickings

During whole harvesting season, aonla growers followed 3 to 10 pickings (Table 4). In middle and north Gujarat zones respectively, about 21.87 and 29.99 % farmers harvested the aonla fruits in more than 8 pickings during whole harvesting season. Higher percentage farmers followed more than 8 picking of fruits in north Gujarat (25.81%) as compared to middle Gujarat (21.87%)

Table 2 Time of harvesting of aonla fruits

Time of harvest	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Morning	75.00	56.25	65.63	47.60	66.66	53.32	59.68
After noon	-	-	-	04.76	-	03.33	01.61
Whole day	25.00	43.75	34.37	47.60	33.34	43.33	38.71

Table 3 Method of harvesting of aonla fruits

Method	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Hand picking	93.75	87.50	90.63	95.24	100.00	96.65	93.55
Fruit picker	06.25	-	03.12	04.76	-	03.35	03.23
Tree shaking	-	12.50	06.25	-	-	-	03.23

Table 4 Number of fruit pickings / season

No. of pickings	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
3	25.00	06.25	15.62	-	-	-	08.07
4	18.75	12.50	15.62	23.80	-	16.66	16.13
5	06.25	25.00	15.62	28.56	22.22	26.66	20.97
6	06.25	18.75	12.50	09.52	11.11	09.99	11.29
7	12.50	12.50	12.50	04.76	22.23	09.99	11.29
8	06.25	06.25	06.25	04.76	11.11	06.66	06.45
>8	25.00	18.75	21.87	28.56	33.33	29.99	25.81

Range: 3-10

Manpower for harvesting

The manpower employed for harvesting aonla orchards varied from 2 to 15 persons. About 45.64 % aonla growers employed 3 to 6 persons for harvesting of the aonla fruits in the state (Fig. 1). Higher manpower was employed for harvesting in the middle Gujarat as compared to the north Gujarat region. About 50 % of orchards in the middle Gujarat and 40 % orchards in the north Gujarat engaged 3 to 6 persons for harvesting of aonla fruits followed by 6 to 9 persons in 25 and 26.66 % orchards in middle and north Gujarat, respectively.

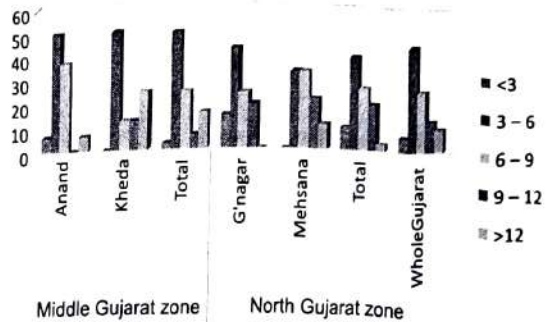


Fig. 1 Manpower for harvesting of aonla orchards

Capacity of aonla harvesting

Harvesting capacity of about two-third orchards of the state was between 50 and 125 kg of aonla / day / person (Fig. 2). About 43.75 % of growers harvested 50 to 100 kg of aonla / day / person and another about 25 % of orchards harvested aonla fruits at the rate of 100 to 150 kg of aonla / day / person in the middle Gujarat. In the north Gujarat, 40 % orchards harvested aonla fruits at the rate of 50 to 100 kg / day / person, while another about 30 % of orchards harvested aonla fruits at the rate of 100 to 150 kg / day / person. The efficiency of the manpower employed was more in middle Gujarat as compared to the north Gujarat.

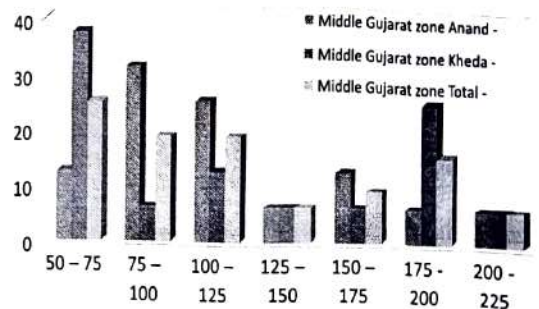


Fig. 2 Capacity of aonla fruit harvesting

Fruit yield

In Gujarat, majority of the orchards (about 60 %) yielded the fruits at the rate of 50-150 kg per tree (Table 5). The average yield in the state was estimated as about 84 kg/tree. In the middle Gujarat zone, about 31.25 % of the orchards had fruit yield in the range of 50 to 100 kg / tree. Another about 25 %

orchards had low yield (<50 kg/tree). While only about 9.37 % orchards of the middle Gujarat yielded more than 200 kg fruits / tree. Similarly, in north Gujarat area also, about 60 % of orchards yielded fruits in the range of 50 to 150 kg fruits / tree (Table 5). Only 16.66 % orchards yielded more than 150 kg / tree fruits in north Gujarat.

Table 5 Fruit yield per tree of aonla (kg/tree)

Fruit yield (Kg/tree)	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
<50	37.50	12.50	25.00	33.32	-	23.33	24.19
50 – 100	25.00	37.50	31.25	23.80	44.45	29.99	30.65
100–150	25.00	31.25	28.12	28.56	33.33	29.99	29.03
150–200	06.25	06.25	06.25	14.28	11.12	13.33	09.68
200–250	06.25	-	03.12	-	11.11	03.33	03.23
>250	-	12.50	06.25	-	-	-	03.23

Range: 15-340 kg/tree Average: 84.06 kg/tree

Harvesting losses

The percent harvesting losses of fruits were about 2-4 % in about half of the orchards surveyed. In Gujarat, 2-4 % harvesting losses were found in 56.46 % orchards and 1-2 % harvesting losses were found in 19.36 % orchards (Fig. 3). In north Gujarat about 30 % orchards had harvesting losses in the range of 1 to 2 %. More than 4 % losses were found in about 25 % orchards in middle and 23.33 % orchards in north Gujarat. The harvesting losses were observed higher in the orchard of middle Gujarat where the tree shaking method employed by the farmers to harvest the fruits.

*2. Grading**Fruit grading criteria*

Grading in terms of only sorting is being followed by the farmers. Size and colour are the major criteria followed for grading of aonla fruits. About 61.29 % aonla growers considered only fruit size for grading (Fig. 4). About 65.62 % of aonla growers in middle Gujarat and 56.66 % of aonla growers in north Gujarat adopted the fruit size as a grading criteria. Very less percentage of orchards followed injury, diseases spot and maturity of the fruits as grading criteria.

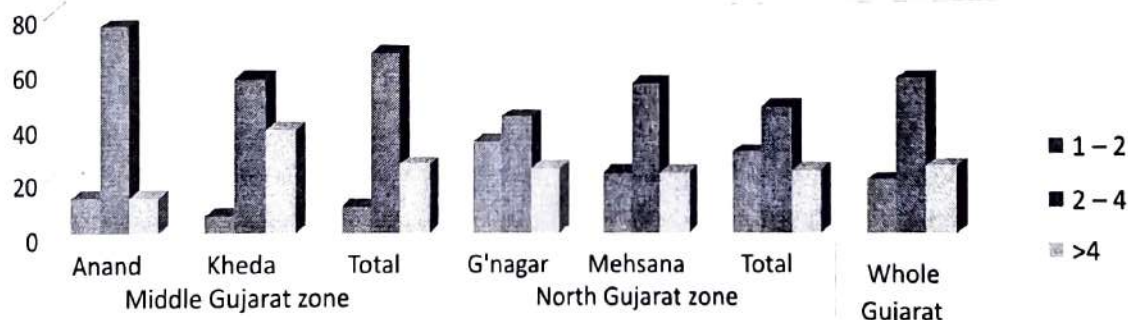


Fig. 3 Harvesting losses of aonla

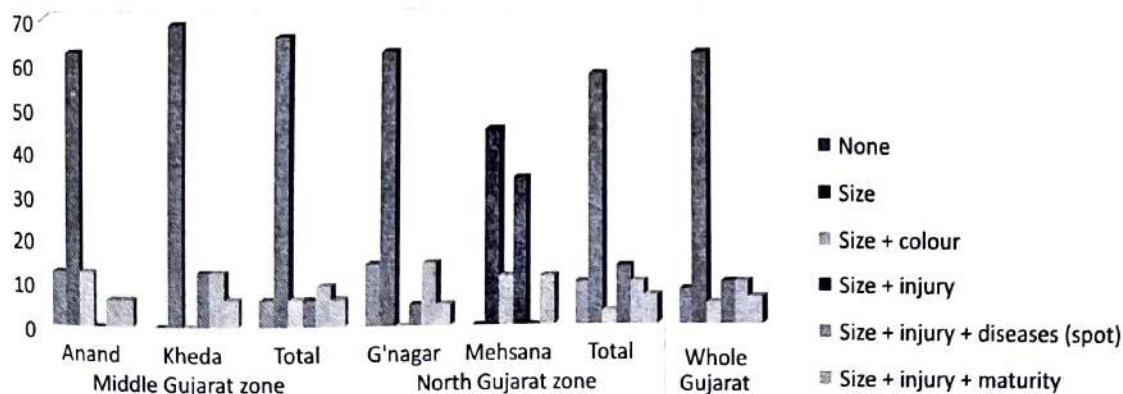


Fig. 4 Grading criteria followed by aonla growers

Grading / sorting method

Manual grading and sorting is the common practice in both the zones . About 92 % aonla farmers of Gujarat followed manual grading (Fig. 5). Nowhere in the state, the mechanical grading was being followed. In middle and north Gujarat about 93.74 and 90 % growers, respectively followed manual grading and sorting practices. The rest aonla growers do not follow any grading & sorting practices for aonla fruits.

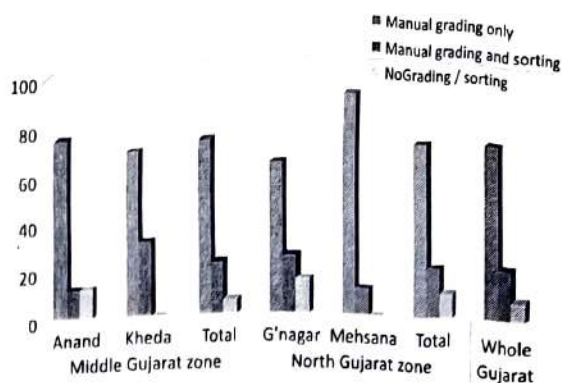


Fig. 5 Method of aonla grading practiced by the farmers

Number of grades

Aonla growers generally, classify fruits into 2 to 4 grades namely i)large and small ii)large , medium, small and infected/injured fruits only. Three grades(large , small and infected) common practice was followed by aonla growers of the state.About 63 to 65 % farmers in both the zones graded the fruits into 3 grades (Fig. 6). viz., big, small and infected. About 13.33 - 15.62 % farmers of both zones classify the fruits into 4 grades, in which the medium size grade is added to above. About 13 % farmers followed grading by removing only small and injured fruits from the bulk.

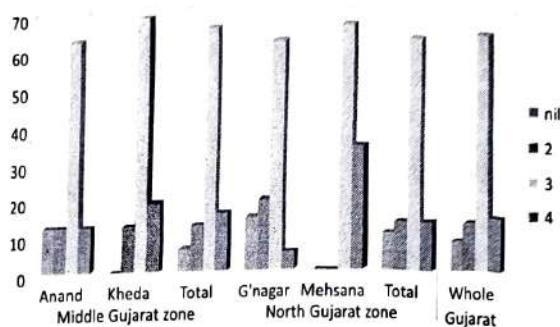


Fig. 6 No. of grades of aonla fruits

Manpower for grading

Majority (about 65 %) of the aonla farmers of the state employed 3-5 persons for grading of aonla fruit (Table 6). About two-third of the orchards engaged 3 to 5 persons for grading in the middle Gujarat as well

as of the north Gujarat region. In both the regions, 10 to 12.50 % orchards engaged 6 or more than 6 persons for grading the fruits. Remaining (21 – 24 %) farmers employed 2 or less than 2 persons for grading of the fruits.

Table 6 Manpower for grading of aonla fruits

No. of persons	Percentage of Orchards						
	Middle Gujarat zone			North Gujarat zone			Whole Gujarat
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
0-2	25.00	18.75	21.87	28.56	22.22	26.64	24.15
3-5	68.75	62.50	65.61	61.88	66.66	63.31	64.61
>6	06.25	18.75	12.50	09.52	11.11	09.99	11.26

Range: 1-6 person

Average: 2.16 persons

Capacity of aonla grading

Majority of the aonla growers of the state (about 56 %) followed the grading of aonla fruits with capacity of 100-200 kg/ day / person (Table 7). Higher capacity (200-300 kg/day/person was observed for

about one third orchards in the middle Gujarat region. About 9.38% orchards graded fruits with higher efficiently (>300 kg/day/person), in middle Gujarat.

Table 7 Quantity of aonla fruits graded per day per person

Quantity (kg)	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
<100	12.50	-	06.25	23.80	-	16.66	11.29
100 – 200	56.25	43.75	50.00	61.88	66.66	63.32	56.46
200 – 300	25.00	43.75	34.37	14.28	33.34	19.99	27.42
>300	06.25	12.50	09.38	-	-	-	04.84

Range: 80-375 kg

Average: 182 kg

3. Packaging

Type of packaging

About 85 % aonla farmers of Gujarat follow packaging of aonla fruits at orchard level while remaining 15 % do not follow any packaging and sale only loose produce in bulk (Fig. 7). Most of the growers use gunny bag to pack the fruits where as very few farmers use the plastic lined bag.

Package size

The weight of the gunny bag package was found in the range of 30 to 50 kg. In the middle Gujarat region, about 34.37 % farmers follow 40 - 45 kg, 28.13 % farmers follow 35 - 40 kg and 21.87 % farmers follow 45 - 50 kg package size. While in north Gujarat, 33.33 % farmers follow 40 - 45 kg package size where as about 23 % farmers followed 45-50 and 35-40 kg packaging (Fig. 8).

Cushioning material

About 59.38 % aonla farmers in middle Gujarat do not use any cushioning material in the gunny bag packaging of aonla, while remaining about 40 % farmers use green leaves (PALI) of aonla or of other (Neem, Gulmahor, etc) trees leaves as cushioning material in gunny bag packaging (Fig. 9). In north Gujarat, 43.32 % aonla farmers do not use any cushioning material, while remaining 56.68 % farmers use green leaves of trees. These leaves are put at the bottom of the package before filling the fruits as well as at the top of package after filling. However, more than half of the aonla farmers of the state do not use any cushioning material in the packaging.



Fig. 7 Type of on-farm packaging followed by aonla growers

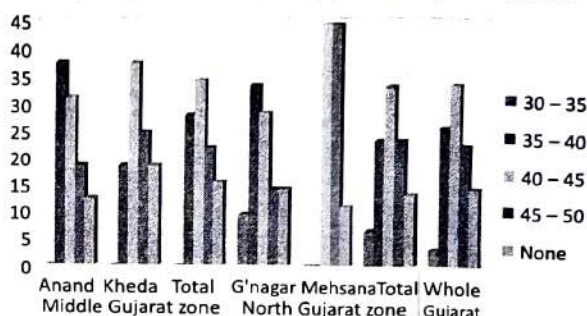


Fig. 8 Size of package followed for aonla fruits

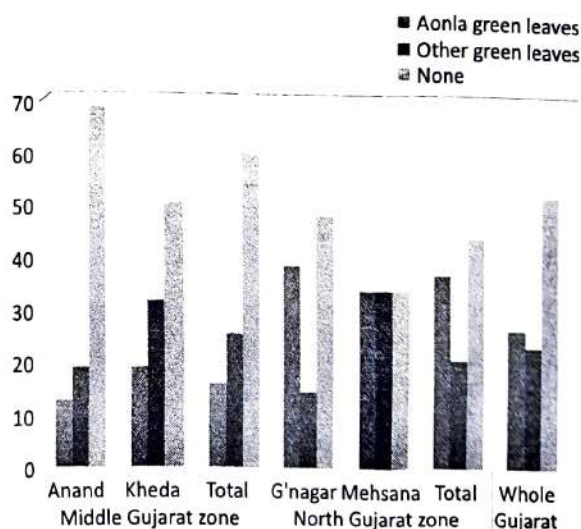


Fig. 9 Cushioning material used by the aonla growers

4. Transportation

Dispatch time for marketing

About 81.25 % farmers in the middle Gujarat zone and 66.67 % in north Gujarat dispatch the aonla fruits in the evening for marketing. The harvested fruits in morning hours, are graded and packaged in

afternoon and dispatched in the evening for marketing to wholesale market. The remaining 18.75 % and 33.33 % growers, respectively in middle and north Gujarat, dispatch their produce in the morning. About 74.20 % aonla farmers of the state dispatch their produce in the evening (Table 8).

Table 8 Time of dispatch for marketing of aonla fruits

Time	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Morning	18.75	18.75	18.75	38.12	22.22	33.33	25.81
Evening	81.25	81.25	81.25	61.88	77.78	66.67	74.20

Transportation vehicle

Majority of the aonla growers (>85%) use hired vehicles for transportation of aonla fruits from orchard to market (Table 9). Very few farmers have

their own vehicle for transportation of the fruits. This may be due to the fact that the majority of orchards were given to contractor on lease.

Table 9 Vehicle ownership for transport of aonla fruits

Owner-ship	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Own vehicle	06.25	18.75	12.50	19.08	11.12	16.68	14.52
Hired vehicle	93.75	81.25	87.50	80.92	88.88	83.32	85.48

The major mode of transporting aonla fruits from field to market was low capacity vehicles such as loading Ricksha, Chhakada and matador in both the regions as the quantity being transported at a time is limited

(Table 10). In few cases, fruits are transported to the market in jointly hired vehicle along with other produce such as vegetables.

Table 10 Vehicle employed for transport of aonla fruits

Vehicle type	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Rickshwa / Chhakada	37.50	31.25	34.38	52.36	33.33	46.66	40.32
Tempo / Matador	37.50	43.75	40.63	38.08	55.55	43.32	41.94
Tractor trolley	-	06.25	03.12	-	-	-	01.61
Loaded truck	-	12.50	06.25	-	-	-	02.23
Not fix (as per availability)	25.00	06.25	15.62	09.52	-	06.66	11.29
Jeep	-	-	-	-	11.11	03.33	01.61

Distance travelled

Distance travelled for transportation of aonla fruits varied from < 50 to 300 km. About 53.12 % of the farmers despatched fruits at a distance between 50 to 100 km in middle Gujarat where as 46.66 % farmers marketed fruit to market situated between

50 to 100 km in north Gujarat (Table 11). The produce of the majority of the aonla farmers in Gujarat travelled up to 100 km distance for marketing. The distance aonla growers travelled for marketing of aonla fruits was found more for middle Gujarat as compared to the north Gujarat.

Table 11 Transporting distance of aonla from field to the market

Distance (km)	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
< 50	37.50	25.00	31.25	57.12	22.22	46.66	38.71
50 – 100	50.00	56.25	53.12	38.08	66.66	46.66	50.00
100–150	06.25	06.25	06.25	04.76	11.11	06.66	06.45
150–200	06.25	-	03.12	-	-	-	01.61
200–250	-	06.25	03.13	-	-	-	01.61
>250	-	06.25	03.12	-	-	-	01.61

Range: 5-300 km

Average: 63.64 km

Time required for transportation

Majority of the aonla growers of Gujarat takes up to 2 h in transportation of aonla fruits from orchard to the markets (Table 12). In middle Gujarat, 46.87 %

growers take 1 to 2 hours in transportation and 21.87 % growers take less than 1 h. In north Gujarat, 59.99 % farmers take 1 to 2 hours and 36.66 % farmers take less than one hour.

Table 12 Time taken in transportation of aonla from the orchard to the market

Time (h)	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
< 1	31.25	12.50	21.87	38.08	33.33	36.66	29.03
1 – 2	43.75	50.00	46.87	61.88	55.55	59.99	53.23
2 – 3	18.75	25.00	21.87	-	11.12	03.34	12.90
3 – 5	-	06.25	03.13	-	-	-	01.61
>5	06.25	06.25	06.25	-	-	-	02.23

Range: 0.5 - 7 h

Average: 1.86 h

Transportation losses

Transportation losses observed in the range of 1.0 to 5.0 % for both the region of the state (Table 13). In middle Gujarat region, for about one - third of the orchards, the transportation losses were about 2.0-3.0 % and for about 19 % orchards, these losses

were higher up to 4 %. While, the transportation losses observed slightly lower for the north Gujarat zone. About 43 % orchards had about 2 % losses and another about 30 % growers had about 3 % losses (Table 13).

Table 13 Transportation losses for aonla fruits

Losses (%)	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
1	-	06.25	03.12	23.80	-	16.66	09.68
2	37.50	25.00	31.25	47.60	33.33	43.33	37.10
3	43.75	25.00	34.37	23.80	44.45	29.99	32.26
4	12.50	25.00	18.75	04.76	22.22	09.99	14.52
5	06.25	18.75	12.50	-	-	-	06.45

Range: 1-5 %

Average: 2.61 %

5. Storage

No farmer is storing the aonla fruits. Whatever quantity of fruits harvested, is transported to the market on the same day or latest by the next day morning.

6. Processing of aonla at domestic level

Aonla flakes, candy, powder, *murabba*, pickles, *chyanprash* and aonla juice are the processed products of aonla fruits. Very few of aonla processed by the farmers for their domestic quantities consumption.

7. Marketing

There are two systems prevailing for the disposal of fruits from the aonla orchard to market; (a) leasing out of the whole aonla orchard on contract after flowering starts and (b) by self management. In middle Gujarat, 84.37 % farmers gave their orchards to the contractor on lease. This figure was about 73 % for north Gujarat and 79 % for whole Gujarat (Table 14). The contractor in the majority cases takes the produce to the market.

Table 14 Method of aonla marketing

Method	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
To contractor	81.25	87.50	84.37	66.65	88.88	73.33	79.04
Self	18.75	12.50	15.63	33.35	11.11	26.67	20.96

8. Problems faced in post harvest handling system:

In middle and north Gujarat, 43.75 and 26.66 % farmers, respectively were facing the problems in harvesting, grading and transport operations. In north Gujarat, about 40 % farmers reported the major

problems in harvesting and grading, where as in middle Gujarat, 37.50 % farmers also found problems in these two operations. In north Gujarat about 20 % farmers reported problems in only harvesting (Table 15).

Table 15 Problematic post harvest handling operations

Operation	Percentage of Orchards						Whole Gujarat
	Middle Gujarat zone			North Gujarat zone			
	Anand	Kheda	Total	G'nagar	Mehsana	Total	
Harvesting only	06.25	12.50	09.37	23.80	11.11	19.99	14.52
Grading only	-	06.25	03.12	04.76	11.11	06.66	04.84
Harvesting + grading	37.50	37.50	37.50	38.08	44.44	39.99	38.71
Harvesting + grading + transport	43.75	43.75	43.75	23.80	33.33	26.66	35.49
Marketing + rate	-	-	-	09.52	-	06.66	03.23
Transport+ rate	12.50	-	06.25	-	-	-	03.23

CONCLUSION

Change in fruit surface colour was the main maturity index for aonla fruit harvesting followed by the farmers. The farmers preferred harvesting of aonla fruits in the morning. Manual harvesting and collection was followed by majority of the farmers with lower harvesting capacity (111.20 kg/day/person) and higher harvesting losses (1-6%). Average harvesting losses were found 3.10 %. During whole harvesting season, aonla growers followed 3.0 to 10.0 pickings. Very few farmers used

the fruit picker for harvesting aonla. Average fruit yield per tree was 84 kg. Manual grading with very low capacity (182 kg /day/person) was followed by aonla farmers. Aonla farmers adopted, fruit size as the main grading criteria and classified the fruits into 3 grades. About 85 % farmers used gunny bag for packaging with an average package size of 40 - 50 kg. Green leaves of trees were used as cushioning material. Farmers dispatch the aonla fruits to the wholesale market in evening with hired and low

capacity vehicles like loading Rickshaw, Chhakada, matador, etc. The produce of the majority of the farmers in Gujarat travelled up to 100 km. The transportation losses were found between 1.0 and 5.0 % with an average value of 2.6 %. Storage of aonla fruits was not performed at orchard level. Harvested aonla fruits taken to the wholesale market on the same day or in few cases latest by the next day morning. Harvesting, grading and transportation were the most problematic operations in post harvest handling of aonla fruits at orchard level. Post harvest handling losses of aonla fruits was found in range of 8.0–23.0 %.

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