Tropical Agricultural Research Vol. 11 1999, 61-73

Quality Defects in Manually Processed Cashew: Incidents, Origins and Recommendations

V. Hidellage and U. Samarajeewa[1] .

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

ABSTRACT. *A high incidence of quality defects was observed in cashew kernels at the point of export. Cashew processing is done in two phases: cottage based initial processing involving shelling and peeling, and a second phase of drying and grading at collection centres. As processing proceeds from initial to final stages kernels with brown patches increased from 6 to 8%, scratched or scraped kernels from 7 to 12%, and the colour changed from pale ivory to yellow with score of hedonic scale rising from 6 to 8. Rejects at export stage were 40%. The balance 60% accepted for export showed 3% brown patches, 4% scraped or scratched kernels, and colour score of 6, making it impossible to meet specifications of grade I cashew kernels.*

Technology and practices of processing contributing to defects include, contamination of kernel from cashew shells (CNSL) during shelling; enzymatic discolouration due to prolonged storage of shelled kernels prior to drying; increased brown spots due to overheating/burning and scratched kernels due to excessive handling at heating and drying. The scraped kernels also increased while attempting to remove the brown patches. Women engaged in processing of cashew at home were unaware of market needs, as they do not come in contact with buyers of processed cashew for export. The processed kernels are supplied to exporter by the persons operating dryers and servicing as collecting centres. Quality concerns are overlooked in all stages of processing permitting sale of low quality cashew.

Educating processors on market requirements, introducing roasting raw nuts prior to shelling to reduce CNSL contamination and drying kernels immediately after shelling to reduce discolouration and breakage of kernel due to excessive handling are essential. Operation of dryers with quality control measures is recommended to improve quality of kernels.

---

1 Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka.

INTRODUCTION

Cashew is one of the main income earners amongst non-traditional agricultural export crops from Sri Lanka (Central Bank of Sri Lanka, 1998). Cashew processing at cottage level creates employment for about 30,000 (Ariyabandu *et al.*, 1995). The global demand for cashew kernels is heavily determined by quality standards. The bulk of cashew produced in Sri Lanka fetches low prices in the world market. Sri Lanka is unable to export kernels to sophisticated Western markets, as it cannot meet quality standards required by them. As a means of achieving a quality product, the government introduced regulations in 1996, making inspection of cashew for quality mandatory prior to export. However, this approach has so far not resulted in improvements in quality of kernels for export. Due to a limited availability of raw material for processing, product quality is largely overlooked in desperation to meet quantities demanded.

In Sri Lanka, cashew nuts are processed manually using conventional processing technologies and practices. The poor processing methods appear to be the main cause of quality defects of the product. In this study, attempts are made to identify the defects and their origins, and propose suitable recommendations to improve the quality of processed kernels.

MATERIALS AND METHODS

Manual processing of cashew

A sample of 10 villages was selected to represent cashew processing areas except those in North and East of Sri Lanka. Six processors engaged in manual processing from each village were identified. They represent at least 50% of processors in eight villages, and about 25% of total cashew processors in the other two villages. Operations carried out by the 60 processors were observed individually, and discussed. Gender division of labour in each operation was recorded. The operations that need to be further studied to recognise origins of defects were identified, by assessing the methods and technology used.

Effect of initial home/cottage based operations on quality

Whole cashew kernels (500 g) were collected from each processor. This sample was drawn from the bulk cashew stock (varying from 5-15 kg)

ready for collection by middlemen. Samples were taken from top of the stock as extensive handling (mixing) can damage kernels further. Samples were pooled village wise, and quality defects in relation to colour, black spots and appearance (scraped/scratched appearance) of the surface were identified. Kernels were graded by colour using a hedonic scale of 1 to 10 with a range of light grey (1) to ivory to light yellow (10). Kernels showing more than one tenth (1/10) of surface area with brown patches were identified as defective. The kernels with 25% scratched or scraped surface were also identified as defective. Detailed practices, quantity of input and output, outputs of grades and time spent were recorded for each operation.

Effects of drying and grading at collecting centres on quality

Processed kernels (500 g) were collected from twelve collecting centres in Gampaha, Kurunegala and Puttalam. The kernels were drawn from the top of randomly selected 5 kg bags ready for delivery to exporters. Kernels were examined separately for quality defects using the same criteria and methods as earlier. Kernels were checked for case hardening which occurs after two weeks of storage. Kernels were cut across and centres were probed with a needlepoint for texture difference due to trapped moisture. Equipment used by each processor was examined in relation to type of oven, capacity, quality control measures (temperature control, airflow *etc.*). Steps in the process of drying the kernels in the oven were observed and discussed. Details of operations, weight of kernels before and after drying and grading, recovery of various grades and time taken for the operations were recorded.

Quality defects of manually processed cashews at the point of export

Whole cashew kernels (1 kg) were collected from 5 exporters. Quality defects of each sample were assessed using the selected criteria as described under 2.2. The results were compared with USA standards for kernels (Abayasiri, 1995). Whole cashew kernels (1 kg) were also collected from the rejects and analysed for defects as given above.

RESULTS AND DISCUSSION

Manual processing of cashew

The operations that comprise manual processing of cashew from the raw nut stage to export point are given in Table 1. The process can be identified in two phases: an initial phase of processing consisting of shelling and peeling which is mainly home or cottage based and a second phase when drying and grading are done at collecting centres. The two phases differ from each other by the nature of persons employed and locations.

In the initial phase, women carry out 93% of manual processing, while men contribute in buying and selling (Figure 1). Drying in oven at collecting centres are carried out by men, while women, mostly wage workers handle 81% of grading and packaging. Processed kernels are sold to exporters by the owners of the collecting centre and not by those engaged in processing. The initial phase of processing is carried out by women at home, using traditional technologies. The women do not get opportunities to understand the market requirements, while the person who controls the second phase of drying serves as the link between market and processors. He specifies the future requirements at the time of collection of kernels. This gap in transfer of market knowledge appears to be a main constraint in motivating those engaged in initial processing, to work towards achieving required product quality in the initial phase.

Study of initial home/cottage based operations

The initial processing causes 14% of product to be defective on the average (Table 2). Of this, 9% of kernels develop brown patches (scorched kernels) and 9% of kernels show scratched/scraped surface together with yellowish colour that corresponds to very poor score of 9 on the hedonic scale. The above mentioned material defects lower the quality of kernel to grade 3 (in western markets). Study of technology and practices used in the initial operations reveals origin of defects.

No notable quality differences were observed among the sundried samples or the output of operation from different villages. There was about 10% weight loss during sun drying. The dried nuts remained in good conditions on storage for over a year. Processors take precautions during shelling, to protect fingers from Cashew Nut Shell Liquid (CNSL) by wrapping old clothing around their fingers and applying ash from burnt

Table 1. Unit operations observed during manual processing of cashew.

Operation	Description
Acceptance of raw nuts	Processors buy 10-100 kg raw nuts depending on cash in hand or receives nuts from businessman (*mudhalali*) on credit.
Sun drying	50-100 kg raw nuts are spread in one layer under bright sun for 6-7 h/day for 2-3 days on mats. Partially dried nuts are covered with polythene at nights. Shaking a few dried nuts together inside palms to generate a 'correct' rattling noise to identify required dryness in the nuts.
Shelling	Processors squat on ground, beating a nut on specific spots 2-3 times with a mallet until shell splits. A hard stone buried in ground serves as a stable platform to hold the nut down as it is beaten. Processor extract kernel carefully with a metal tool that resembles a penknife.
Heating/ Peeling	Kernel has a testa: thin reddish coating around which is peeled. Heating facilitates peeling. A blunt knife like metal tool is used to scrape parts of testa that is difficult to peel, and any brown spots present.
Grading	Kernel is graded to wholes, splits (halves) and pieces and bulk stored in recycled cardboard cartons or polythene bags.
Collecting	Owners of ovens buy kernels from individual processors for drying at the collecting centres.
Drying in oven	Kernels are dried in an electrically heated cabinets that resembles an oven (called oven by processors). Cabinets are of 60-100 kg/h capacity with no temperature and air flow control and are made locally according to description given by oven owner, or designed at a local workshop based on individual requirement. Cabinet is loaded with about 10 trays of kernels (about 3" thick layer of cashew on a tray) and dried for 3-3½ h. Thereafter positions of trays are changed and nuts mixed/stirred. After another hour of drying electricity is switched off, leaving kernels inside the oven for 1 to 2 h to complete drying. Kernels are examined for dryness by observing for colour, texture and shaking a few nuts together to get the 'right' sound. Temperature inside cabinet varies (about 175°C near the heater) and fluctuate as doors are opened.
Grading	Whole kernels are graded to sizes: 180 W, 240 W, and 320 W*. Bigger nuts are priced higher.
Packaging	Kernels are packed according to grades in 5 kg polythene bags.
Delivery to exporters	Bags of kernels are delivered to stores of exporters mainly in Colombo, and receive payment of about 50-60% of the value delivery and balance in about week after quality inspection.

The figure in front of 'W' indicates number of kernels per lb.

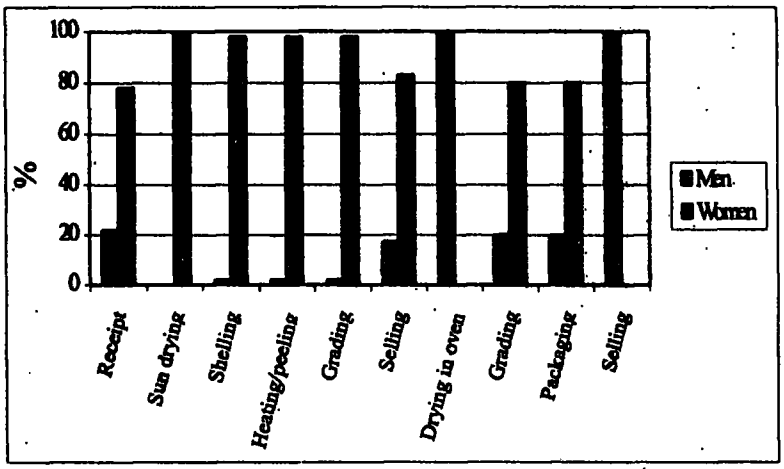

Figure 1. **Percentage contribution by men and women in unit operations of cashew processing.**

Table 2. **Quality defects observed in cashew kernels after first phase of cottage level processing.**

Village	Brown patches %	Scraped/scratched surface %	Colour score	Total defects %
Arachchiwatte	6	7	7	15
Bodarakanda	21	12	12	24
Buruthakele	7	7	7	12
Kaluwelgoda	5	7	7	13
Karuwalagaswewa	16	13	12	18
Madelgamuwa	5	7	7	12
Santhanagama	14	10	12	15
Vanatahvilluwa	7	8	8	9
Vijekatupotha	7	7	7	13
Vilpotha	6	7	7	11
MEAN	9	9	9	14
SD	6	2	2	4

firewood on fingers. Contamination of kernels with CNSL and ash occurs during handling. CNSL contamination leads to development of patches at roasting, making kernels unacceptable. Processors usually shell a 'load' of raw nuts (50-100 kg) over 3-6 days continuously before commencing peeling of testa. Storage of shelled kernels without immediate drying in boxes, gunny bags or polythene bags, permit continuous enzymatic action for several days leading to discolouration, exposure to insect attack and contamination with foreign particles. Major changes to processing practices need to be introduced at this stage to prevent setting in deteriorative activities.

Heating is carried out as a means to facilitate peeling of testa, while processors of some villages resort to sun drying and baking in an oven. Peeling of the testa from kernels is done after heating for a few seconds on a flat pan over a fire created by burning paddy husks, testa itself or firewood. Testa is removed immediately off the hot kernels. Overheating at this stage appears to be a major cause of scorched kernels. Sudden increase in temperature due to wind during roasting and contamination with foreign material cause further reduction of quality. The only restriction that is imposed to improve quality at this stage is paying wage workers for recovery of only the whole kernels. This incentive is aimed only at improving recovery of whole kernels, but not the other quality criteria.

Processors from different areas have different levels of output/person hour, and recovery of whole kernels. Processors in Gampaha, - the traditional processing centre (Arachchiwatte, Madelgamuwa, Kaluwelgoda), are better skilled, while processors of areas such as Bodarakanda (Matara) and Karuwalagaswewa (Anuradhapura), Santhanagama (Kurunegala) where processing started recently, possess poor skills. Higher quality defects (Table 2), higher percentage of broken kernels (splits and pieces) and lower productivity levels (Table 3) are observed in the product from the villages that have started processing recently.

Study of drying and grading at collecting centres

After drying and grading, quality defects are recorded as 13%, including 8% brown patches, 8% scratched surfaces and colour score of 8 (Table 4). At the point of supplying to the collecting centres kernels carry higher quality defects as shown in Table 2. Low levels of defects observed after grading, is a result of selective collection of kernel from cashew processing villages to collecting centres.

Table 3. **The time spent and percentage output of cashew kernels on first phase of manual processing in different villages.**

Village	% Out put of				Time spent on manual processing (h/person)
	Wholes	Splits	Pieces	Total	
Arachchiwatte	17	4	3	24	59
Madelgamuwa	17	3	3	23	60
Kaluwelgoda	17	4	3	24	60
Santhanagama	9	7	7	23	82
Vanatahvilluwa	14	6	2	22	75
Vilpotha	14	5	3	22	66
Buruthakele	13	6	6	25	72
Vijekatupotha	13	6	4	23	72
Karuwalagaswewa	10	7	7	24	88
Bodarakanda	5	8	6	19	93
MEAN	13	6	4	23	73
SD	4	1	2	2	12

Table 4. **Quality defects detected in kernels after drying and grading at collecting centers.**

Sample	Brown patches %	Scraped/scratched surface %	Colour score	Case hardening %	Total defects %
1	8	8	8	12	13
2	7	9	8	11	13
3	8	9	7	12	14
4	7	9	8	12	14
5	8	8	7	10	12
6	9	8	7	11	13
7	8	9	8	11	12
8	8	9	7	11	13
9	7	8	8	12	14
10	9	8	8	12	14
11	8	8	7	12	14
12	7	8	7	10	13
MEAN	8	8	8	11	13
SD	1	1	1	1	1

Kernels processed in villages that have very low productivity levels (Santhanagama, Karuwalagaswewa and Bodarakanda) are sold to closest urban centres for local market. Collecting kernels for drying from these villages do not seem to occur. The quality defects given in Table 4 are the mean values for 10 villages. Kernels from the 7 villages where cashew kernels are collected show an average colour score of 7, brown patches in 6% and scraped surface in 7%. The percentages of quality defects after drying and grading (Table 4) in comparison to above show an increase.

The number of scorched kernel with brown patches increased further during oven drying due to high temperature pockets near electrical heaters (that initially heat up the oven to about 175°C to 200°C) and lack of temperature and airflow control. Excessive handling and intermittent stirring/mixing of kernels against metal mesh of trays during drying reduced whole kernel percentage from 65 to 55, increased broken grades (splits from 20% to 28% and pieces from 15%to 17%) and scraped/scratched kernels from 7% to 9%. Drying in ovens resulted in 11% casehardened kernels after drying (Table 4).

Quality defects of cashew kernels prepared for export market

Samples collected from exporters had an average colour score of 6 corresponding to light yellow, an average of 3% scorched kernels and 4% scratched/scraped surfaces (Table 4) that would slow up on roasting. As a result, the samples cannot be categorized as grade I. The grade II quality allows 2-3% of scorched kernels and third quality up to 10%. The tolerance of scraped kernels is up to 5% in grade II and III. The sample may be categorized as grade II.

Western markets prefer whole kernels with ivory colour, free from scorched and scraped nuts. There is accumulation of defects (Figure 2) and decrease of whole kernel (Figure 3) as processing progresses from shelling nuts to drying and grading of kernels. The high incidence of defects (colour, scorched and scraped surface) in final product is a cumulative result of events occurring at different stages of processing. The exporters check kernels for quality and reject at least 37% of the product delivered to them (Table 5). Even at export point a fair amount of quality defects were observed (Table 6). The kernels accepted for export show much lower defects than what is shown in the product of collecting centers, as they are graded and only 60% kernels are accepted. Production of kernel of consistent quality through existing technology, practices and processors with varying skill levels appeared

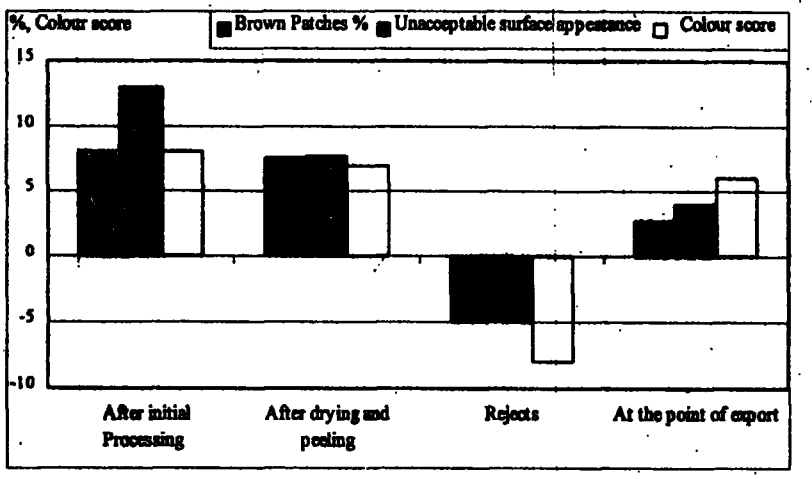

Figure 2. **Quality defects detected at each step of processing.**

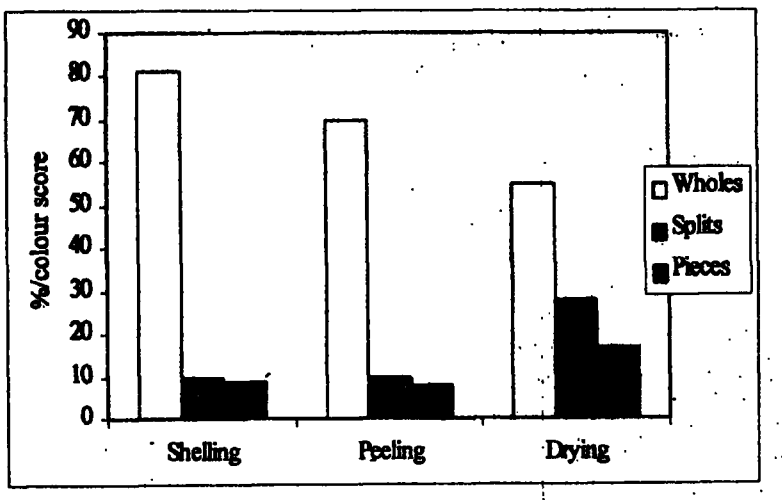

Figure 3. **Recovery of wholes, splits and pieces at different stages of processing.**

Table 5. Analysis of defects of rejected kernels at the point of delivery to exporter.

Exporter	Brown patches %	Scraped/scratched surface %	Colour score	Other %	Pieces %	Splits %
1	4	5	8	6	8	5
2	5	6	9	8	6	5
3	5	4	8	6	7	4
4	5	5	8	7	7	6
5	4	5	8	7	7	5
MEAN	5	5	8	7	7	5
SD	1	1	0	1	1	1

Table 6. Quality defects of cashew kernels at the point of export.

Sample	Brown patches %	Scraped/scratched surface %	Colour score	Average defects %
1	2	4	6	6
2	3	4	7	7
3	3	4	6	6
4	3	4	6	6
5	2	3	6	6
MEAN	3	4	6	6
SD	0	0	0	0

extremely difficult. Rejecting at the point of purchase by exporter does not help to improve processing practices, as local markets absorb defective kernels. The inability of exporter to buy sufficient quantities of kernels to meet market demand has resulted in purchase of low quality kernels to supply the Middle East countries (Abayasiri, 1995) where stringent quality standards are not enforced.

The improvement of quality thus needs a concerted effort at all stages of processing through proper educational programmes and adoption of appropriate technology as recommended below.

RECOMMENDATIONS

Alternatives based on technology and practices of well established industry elsewhere that produces output of required quality should be adapted and introduced to manual processors. Such development should consider following:

* Awareness creation on standards, quality and market requirement.
* Training of processors to impart skills.
* Roasting nuts prior to shelling to reduce CNSL contamination of kernels (Sri Lanka Standard Institution, 1993).
* Shelled kernels should be dried immediately after shelling, to minimise enzymatic discolouration that contributes to darker colour of kernel.
* Use of dryers with quality control measures (controlled temperature, air flow, drying mass).
* Dried kernels should be peeled immediately.
* The peeled kernels should be simultaneously graded to sizes and packed separately as required by the markets (Bureau of Ceylon Standards, Sri Lanka, 1976).
* Heating prior to peeling and drying in ovens as practiced now should be replaced by proposed drying operation.

ACKNOWLEDGEMENTS

Intermediate Technology Development Group Sri Lanka is gratefully acknowledged for the assistance.

REFERENCES

Abayasiri, J.P.L. (1995). Cashew information analysis: Agro products series 3. Trade Information Service. pp. 22-24. Sri Lanka Export Development Board.

Ariyabandu, M.L.M. and Hidellage, V. (1994). Impact of structural adjustment policies on small scale producers in South Asia. pp. 73-75. *In*: Twigg, J.B.A. (Ed). Intermediate Technology Development Group, Sri Lanka.

Bureau of Ceylon Standards, Sri Lanka. (1976). Specification for cashew kernels. Sri Lanka Standard. 405: 1976 UDC 634, 573.

Central Bank of Sri Lanka. (1998). Annual Report Annex. Table 85. pp. 598-599.

Ohler, J.G. (1988). Cashew, Communication 71, Department of Agricultural Research, Royal Tropical Institute, ICG Printing, Netherlands.

Sri Lanka Standard Institution. (1993). Code of practice for processing of cashew nuts. Sri Lanka Standard. 1003: 1993 UDC 634, 573, 022.2 .