

Production of Noni Juice and Powder in Samoa

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There are two main islands in Samoa with a total area of approximately 2900 square kilometers. Both islands are wholly volcanic in origin, consisting of basalt from which various latosolic soils have developed.

On these soils and on lava flows, the noni tree grows wild in various topographical situations with abundant but variable rainfall (2500 to 8500 mm). There are very few cultivated plots in Samoa. Nearly all the fruit gathered for processing is from wild trees. Although organic certification of these source trees is not possible, the fruit is, in reality, organically grown.

Contrary to some published warnings, Samoan noni fruit does not contain toxic levels of lead, or mercury, nor of cadmium, zinc and arsenic.

The Samoan noni tree differs morphologically from the Hawaiian noni tree grown under similar conditions in the following way:

Leaves Samoan: elliptical
Hawaiian: ovoid

Fruit Samoan: smaller, generally conical
Hawaiian: larger, more blocky, rounded at end

For the production of noni juice and powder, the systems used have been developed essentially by trial and error.

Juice production

Raw material

Only mature fully ripe yellow fruit is used, i.e. fruit that is yellow but still firm or hard. Any green fruit supplied by growers is rejected, as it seems to result in a more harsh and bitter flavor in the juice. Any fruit that is discolored, cut, damaged or diseased is also rejected. After purchase, fruit is spread on wire mesh tables for washing carefully and thoroughly, with high-pressure water spray. Further rejection of fruit takes place at this time.

Pulping

Before starting the pulping process, the pulping machines, tools, buckets and the factory area where pulping takes place, are all sprayed with sterilant. The same procedures are carried out at the completion of operations each day. Usually 25-35 ton of fruit are pulped for each production batch. Pulped material is transferred to 125 liter open head barrels which, when full, are closed and sealed for anaerobic storage of pulp for a minimum period of two months.

Barrels

For the whole process of juice production, 125 liter open head and 100 liter closed head barrels are used. These barrels are food grade, plastic material (classified HMWHDPE-UN approved). Before being used for any purpose, all barrels, whether new or previously used, are cleaned and sterilized. Cleaning is by hand with a high-pressure water spray and scrubbing brush, followed by sterilization with sodium hypochlorite using a ball spray system. Barrel tops and clamps are also treated.

Pressing

At the completion of the two months storage period, pulp drums are opened and the pulp transferred to the juice press. All parts of this unit are washed and sprayed with sterilant prior to commencement of pressing. Pressed juice is discharged into small plastic tubs from which it is transferred through a stainless steel pump into 125 liter cleaned and sterilized open head drums and stored. A period of three weeks is allowed for settling of fine fruit pulp before decanting into 100 liter closed head drums ready for export as 100% pure juice.

Filtration

Depending on market requirements, juice may be filtered prior to shipment using a plate filtration unit (stainless steel), with SEITZ K900 cellulose filters (range 8-20 micron).

Shipping

Most juice is exported in 100 liter closed head barrels. Alternative methods available rely on the use of 1000 liter plastic bladders packed in wooden boxes, or heavy fiberboard containers.

Hygiene

Procedures followed for the production of noni juice place strong emphasis on the need for cleanliness and disinfection or sterilization at every point of the process. Two proprietary compounds are used:

- A strong quaternary ammonium germicide effective against a wide range of Gram-negative and Gram-positive organisms in food processing and manufacturing industries.
- A compound disinfectant antiseptic, didecyl dimethyl ammonium biocide.

As previously indicated, all processing equipment is treated with either of these agents while the drums used for storage are treated with sodium hypochlorite at a concentration of 300 ppm of chlorine by weight, using a pressure spray system at 14 psi.

The whole of the processing factory (4000 square feet) is misted with either of the sterilants alternately each week.

Experimental work

To obtain some information and guidance on the best techniques to use for fruit processing, the following experiments have been carried out:

Whole fruit vs. pulped fruit

Early small-scale experiments (Table I) indicated that more juice could be extracted from pulped fruit than

Table I. Recovery of juice from fruit pulp and whole fruit for varying time intervals.

Material	Fresh fruit weight (kg)	Days stored before extraction	Juice recovered (kg)	Juice recovered (%)
Fruit pulp	27.5	11	17.2	62.5
	26.8	21	17.1	63.8
	26.2	34	17.1	65.0
	31.1	36	20.5	65.9
	27.0	65	18.4	68.1
Total	138.6		90.3	(average) 65.15
Whole fruit	22.3	11	11.2	50.2
	22.8	21	12.65	55.5
	23.6	34	13.22	56.0
	23.8	36	13.75	57.8
	24.0	47	14.5	60.4
Total	139.5	65	80.2	(average) 57.49

Table II. Recovery of juice from fruit pulp and whole fruit for varying time intervals factory production.

Material	Batch no.	Fresh weight (kg)	Days stored before extraction	Juice recovered Weight (kg)	Juice recovered %
Fruit pulp	050600	34,810	58	23,270	66.85
	250900	29,804	64	18,875	63.33
					(average) 65.22
Whole fruit	010302	36,777	63	17,700	48.13

Table III. Recovery of juice from fruit pulp and whole fruit for varying time intervals and the comparison of juice flavour and colour over time.

Material	Fresh weight (kg)	Days stored before extraction	Juice recovered* (kg)	(%)
Pulp	177	7	106.5	59.83
	171	14	110.75	64.77
	176	21	117.50	66.76
	173	28	117.50	67.92
	172	35	120.00	69.77
	178	42	125.50	70.51
	170	49	118.50	69.71
Whole	84	49	39.50	47.00

*Note: All samples were light brownish red in color and had moderately bitter/astringent taste.

from whole fruit. The same set of results also indicated that for both types of raw material, the percentage of juice extracted increased as age of the raw material increased, prior to extraction. Evidence of this difference between fruit pulp and whole fruit, is also found in large-scale production batches, as can be seen in Table II. This shows that from a total of 64.614 tons of fresh-pulped fruit, the average recovery of juice was 65.22%, whereas, from 36.777 tons of fresh whole fruit, the recovery of juice was 48.13%.

In an additional experiment where juice yields from fruit pulp and whole fruit were compared, results showed that when both materials were held in barrels for 49 days before pressing, the yield from fruit pulp was 69.71%, whereas, the yield from whole fruit was 47.00% (Table III).

Age of raw material v. percentage recovery of juice

In Table I, it is shown that percentage recovery of juice increases with age of raw material prior to extraction. This result is confirmed in Table III, the percentage recovery of juice increasing from 59.85% for 7 day old pulp, to 69.71% for 49 day old pulp.

Changes in color and flavor with age

Results in Table III also indicate that when comparisons were made between the color and flavor of juices extracted from pulp of different ages, no changes were evident. The same applies to comparison between juice from pulped fruit and juice from whole fruit.

However, when fresh juice (1-7 weeks) is compared with older juice (6 months), it is found that the color, while remaining basically the same, becomes more intense or darker, and the flavor becomes smoother and more moderate – less harsh.

Analyses

To monitor the levels of some possible microbiological contaminants and chemicals, each batch of juice produced is tested both before the fruit is pressed and at varying intervals after pressing. Some of these test results are summarized in Table IV.

Glucose and fructose are the major sugars in the juice. There is some indication that levels decline with age of juice. The microbiological tests indicate extremely low levels of possible contaminants. Whether these results are a normal consequence of the chemistry of the juice, or whether they are due to the measures taken to ensure a high level of hygiene during fruit processing, is difficult to assess.

Powder production

Raw material

Noni chips are purchased from farmers. Ripe fruit is cut into slices and sun-dried. Normally the fruit is not fully dried and is purchased with approximately 20% moisture content. Further drying is achieved at the processing factory through use of solar drying sheds where moisture content is reduced to approximately 12% over a period of 3-4 weeks. Prior to milling or export, fruit is dried for 1-2 days on a wood fired hot air platform dryer to bring moisture down to 7-8%.

Hand sorting

On completion of drying and prior to milling, dried noni chips are passed over sorting tables with a coarse nylon mesh base. This allows loose dust and powder to fall through the mesh while hand sorting proceeds, to check for any foreign matter.

Table IV. Noni juice analyses, Batches 010302, 220101, 220702, Summary of results according to age of sample*

Test	010302 19 days	010302 32 days	010302 63 days	010302 187 days	220101 14 mo	220101 19 mo	220702 44 days	220702 71 days
Sucrose GC %m/m	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5
Lactose GC %m/m	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5
Maltose GC %m/m	<0.5	<0.1	<0.5	<0.1	<0.5	<0.1	0.1	<0.5
Glucose GC %m/m	2.0	2.0	2.0	1.4	1.5	0.6	1.2	1.2
Fructose GC %m/m	0.9	1.0	0.9	0.8	1.0	0.9	0.9	0.9
pH	3.99	3.87	3.83	3.91	3.97	3.99	3.85	3.80
Aerobic plate count (35C) cfu/g	100	10	<100	<10	<100	<10	210	10
Anaerobic plate count cfu/g	N/A	<10	<10	<10	N/A	<10	<10	<10
Coliforms cfu/g	N/A	<1	<1	<1	N/A	<1	<1	<1
<i>Escherichia coli</i> cfu/g	<10	<10	<1	<10	<10	<10	<10	<10
Yeast cfu/g	<10	1	<1	<1	<10	<1	<1	<1
Mould cfu/g	<10	2	<1	<1	<10	<1	50	20
Salmonella /25g	ND	ND	ND	ND	ND	ND	ND	ND
Enterobacteriaceae cfu/g	<1	<1	<1	<1	<1	<1	<1	<1

*Age of sample = number of days from the start of fruit processing
 ND = not detected.

Milling

The milling process involves three stages. In the first stage, the chips are processed in a hammermill through a 8mm screen. Second and third stage hammermill processing reduces particle size to 2mm and then 1mm or 0.8mm (1000 or 800 micron).

Packing

The standard pack for powder and for dry chips is a double thickness polypropylene sack.

Hygiene

As the noni chips are prepared and sun-dried at the vil-lage level, control of cleanliness and hygiene is not possible. It is quite essential therefore that sterilization of powder is handled by the purchaser and that it be very thorough.

Table V provides an indication of the levels of chemicals and possible microbiological contaminants to be found in noni fruit powder. The sample of powder analyzed was a composite prepared from 400 kg of powder in a shipment of 5000 kg. It is evident that in the powder, there are higher levels of sugars, aerobic organisms, pH and mould. There were no yeasts detected.

Table V. Noni powder analysis composite sample test.

Sucrose GC %m/m	0.5
Lactose GC % m/m	<0.1
Maltose GC % m/m	<0.5
Glucose GC % m/m	2.9
Fructose GC % m/m	3.0
Aerobic Plate Count (35C) cfu/g	26000
Ph	4.55
Anaerobic Plate Count 55C cfu/g	<10
Coliforms cfu/g	<1
<i>Escherichia coli</i> cfu/g	<10
Yeast cfu/g	<1
Mould cfu/g	2000
Salmonella /25g	Not detected
Enterobacteriaceae cfu/g	<1

Footnote: Yeast – Predominant organisms present were moulds. There were no yeasts detected.