Mechanical Sampler for Almonds

pneumatic device designed to select representative samples from bins without damage to nuts proves successful in tests

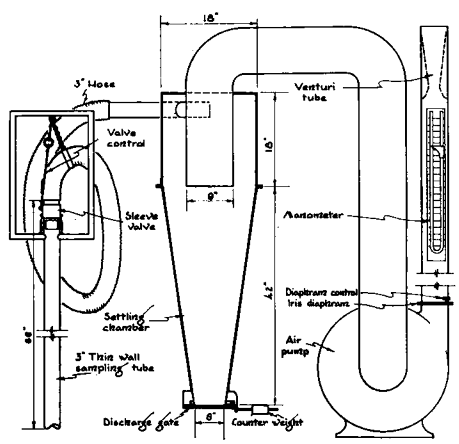
Michael O'Brien

Basic design principles of pneumatic conveying were applied in the construction of a new device for sampling bulk in-shell almonds.

Growers deliver dried hulled almonds to receiving stations in portable 46″ × 46″ × 68″ bins holding up to 2,000 pounds of nuts with a moisture content of 6%. At the receiving stations the bins —usually filled with nuts of the same variety—are weighed and a random sample of the nuts is taken from the top 3″–4″ with a small hand scoop. Grower returns are based on percent of meats to total weight, and percent of good in-shell nuts as determined for the sample —about four pounds—taken from the bin.

Variations in quality of nuts at various levels in the bin—detected occasionally —are considered to be normal. However, possible inequities in payments to growers would be eliminated if an undamaged core of nuts could be sampled from all levels of the bin.

Two experimental sampling devices—a helical 4″ auger and a pointed probe similar to the standard grain probe—were tested in the Sacramento receiving station in the summer of 1957. The auger turned at 100 rpm—revolutions per minute—in a 4″ inside diameter thin wall tube. It was forced down through the nuts to the bottom of the bin, then retracted, and the auger reversed to discharge the sample. The probe had a 3″ diameter and was forced down to the bottom of the bin, opened and agitated to fill, closed, withdrawn and emptied from the large end.



Schematic drawing of the sampling device.

A comparison of the three sampling methods revealed that the scoop involved the least time, effort and damage to nuts, but provided no means of sampling the various strata of nuts. The auger took a stratified sample, but damaged a high percent of the nuts in and adjacent to the sample. The probe also damaged a high percent of the nuts—though less than the auger—and could not sample the bottom 14″ of the bin, because of the long tapered end. Furthermore, it was difficult to manipulate the probe down into the nuts and to close and retract it because nuts lodged in the openings when they were being closed.

The pneumatic sampling device was constructed in the fall and winter of 1957 and tested with IXL, Jordanola, Mission, and Peerless almonds.

The pneumatic sampler has an air pump with a capacity of 675 cubic feet per minute—at 17″ of water—fitted with an iris diaphragm and a manometer to determine the air pressure, velocities, and volumes best suited for lifting almonds from a bulk bin. The air pump is connected to a deceleration chamber by a pipe of 9″ diameter. The deceleration chamber was constructed to provide a centrifugal acceleration of approximately 50 Gs—50 times the nut weight unit—to separate the nuts and chaff from the air stream and leave the exhaust free of dust. The bottom of the cone of the deceleration chamber is fitted with a counter-balanced sponge-rubber-covered gate which serves as a seal during operation and as a gate for discharging the sample when the air is shut off. The center line of the 3″-diameter inlet was

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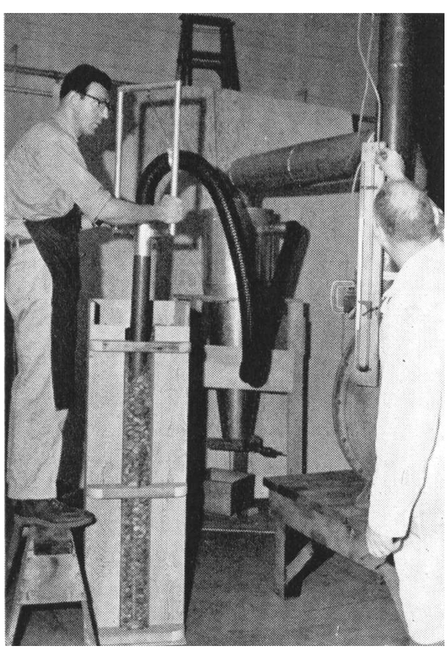
The pneumatic sampling device was tested in this transparent side bin. The manometer tube was used to obtain performance information.



Comparative Percentages for Sampling Criteria Pneumatic Sampler and Scoop Method

Variety	How sampled	Good shell %	Poor shell %	Chaff %	Loose meats %	Shelling %
IXL	Scoop #1	46.0	38.5	11.0	4.5	58.5
IXL	Scoop #2	56.0	40.0	1.0	3.0	63.0
IXL	3″ tube	45.5	37.5	5.5	11.5	64.0
IXL	3″ tube	47.5	37.0	7.0	8.5	62.0
IXL	Scoop #1	66.5	27.5	2.0	4.0	63.5
IXL	Scoop #2	69.0	24.0	3.0	4.0	63.0
IXL	3″ tube #1	61.0	21.5	7.0	10.5	63.0
IXL	3″ tube #2	63.0	24.0	6.0	7.0	63.0
Jordanola	Scoop #1	97.5	sold	2.0	0.5	61.0
Jordanola	Scoop #2	94.0	only	3.5	2.5	62.5
Jordanola	3″ tube #1	91.0	as	4.0	5.0	63.0
Jordanola	3″ tube #2	88.5	meats	6.5	5.0	62.5
Mission	Scoop #1	99.5		0.5		44.5
Mission	Scoop #2	99.5	"	0.5		43.5
Mission	3″ tube #1	98.5		1.0	0.5	44.5
Mission	3″ tube #2	99.0		1.0		45.0
Mission	Scoop #1	99.0		0.5	0.5	45.0
Mission	Scoop #2	99.0	"	1.0		43.5
Mission	3″ tube #1	97.0		2.0	1.0	45.0
Mission	3″ tube #2	97.0		1.5	1.5	44.0

SAMPLER

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placed 4½″ below the top of the deceleration chamber to minimize air drag at the top. The entrance pipe extends into the center line of the cylinder to serve as its own deflector. A flexible tube is used to connect the inlet tube to the sampling tube.

The sampling tube is a 3″-diameter thin-wall tubing 66″ long. The probe end is cut in an elliptical shape to permit maximum air flow through the tube when it nears the bottom of the bin. The top end of the tube is fitted with a finger-tip-operated sleeve valve which is opened when the tube reaches the bottom of the bin. The opened sleeve valve provides an additional flow of air to carry the nuts above the valve through the flexible tube into the deceleration chamber. The velocity of air in the tube diminishes rapidly when the valve is opened, and the nuts in the tube below the valve simply fall to the bottom of the bin. Yoke-type handles are attached to the tube below the valve to facilitate handling the tube.

In operation, the sampling tube is placed in vertical position over a predetermined point on the bin of almonds and the air pump is started. The operator lowers the tube into the almonds, at a rate equal to that which the almonds are carried from the bottom end of the tube. The rate of feed of the tube into the almonds requires a feel by the operator, since too slow a feed results in too large a sample and too fast a feed wedges the nuts, requiring that the tube be lifted to dislodge them.

The amount of air necessary for accelerating and carrying each variety of almond is practically identical. Air channels through the nuts are adequate to provide a sufficient flow of air into the tube at any depth in the bin. Increasing the operating vacuum above 14.5″ of water results in an increase in time required to penetrate to the bottom of a bin 54″ deep. Additional tests will be necessary to determine the significance of this factor.

In the trials with the four varieties of almonds the samples were taken from a bin 16″ × 16″ × 54″. A cylindrical transparent window in the container permitted the observation of the reaction of the nuts during the sampling operation.

Two scoop samples were used as controls and to determine the variation between the two scoop samples. A sample was then taken with the pneumatic sampling; the nuts replenished and another sample taken. The samples were run through the standard sampling procedure at the Sacramento receiving station.

In these preliminary trials there was less variation between the two samples taken with the pneumatic device than between those taken with the scoop. However, because the shelling percent is the primary factor in price determination, further investigations and evaluations are necessary.

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The above progress report is based on Research Project No. 1579.

Operating Pressure, Time, and Weight of Sample for Pneumatic Sampling Device for Sampling Three Varieties of Almonds

Variety	Inches H_2O	Operating inches H_2O	Operating pressure drop inches H_2O	Time Sec.	Wt. sample
Mission	17.2	8.5	9.0	13.0	5.92
Mission	14.5	7.0	7.5	11.0	5.89
Mission	12.0	5.9	6.1	12.5	5.39
Mission	10.0	5.3	4.7	15.0	5.23
Mission	8.0	4.2	3.8	16.0	2.70*
Peerless	17.0	9.3	7.7	13.3	5.52
Peerless	14.5	8.2	6.3	12.2	5.45
Peerless	12.0	6.7	5.3	13.7	5.27
Peerless	10.0	5.7	4.3	14.3	4.92
Peerless	8.0	3.8	4.2	19.2	2.3*
Jordanola	17.5	8.7	8.8	15.0	6.06
Jordanola	14.5	7.9	6.6	14.4	4.72
Jordanola	12.0	7.0	5.0	15.0	4.61
Jordanola	10.0	6.4	3.6	17.2	4.52
Jordanola	8.0	4.8	3.2	18.0	3.58
Jordanola	6.0	3.8	2.2	20.0	2.68*

* Plugged.

Comparison of Data
Samples of different almond varieties taken by conventional scoop and experimental auger and probe in receiving station in Sacramento

Variety	How sampled	Good shell %	Poor shell %	Chaff %	Loose meats %	Shelling %
Nonpareil	Scoop	99.0	0.0	1.0	0.0	63.0
	Auger	62.0	7.0	12.0	19.0	61.0
	Probe	72.0	5.0	3.0	20.0	63.5
Mission	Scoop	99.0	0.0	0.5	0.5	44.5
	Auger	74.0	16.0	6.0	4.0	43.0
	Probe	85.0	9.0	3.0	3.0	45.0
Neplus	Scoop	96.0	2.5	0.5	1.0	60.0
	Auger	51.5	14.0	15.5	19.0	58.5
	Probe	59.5	10.0	11.5	19.0	59.5
Peerless	Scoop	93.0	7.0	0.0	0.0	41.0
	Auger	74.0	17.0	7.0	2.0	39.0
	Probe	77.0	16.0	6.5	0.5	40.5
IXL	Scoop	72.5	26.5	0.5	0.5	59.0
	Auger	23.0	26.5	26.0	25.0	58.0
	Probe	45.5	18.5	21.0	16.0	60.5
Jordanola	Scoop	94.0	2.0	2.0	2.0	62.0
	Auger	12.0	5.0	2.4	14.0	61.5
	Probe	42.0	3.0	1.6	12.0	63.0

MARKETS

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come positions of both producer and first-handler firms to the actions of the other encourages increased integration.

Cooperative Associations

In producer marketing cooperatives in the western region, the growers actually own and operate assembly, processing, and selling facilities, but the methods and techniques employed by most cooperative organizations do not seem to facilitate optimum coordination. Characteristically, the association member has remained largely autonomous in making production decisions. The task of the cooperative organization consists primarily of preparing the product in the most advantageous manner through grading, sorting, or processing, and then selling it for the highest possible return.

A constraint is placed upon cooperative management in that it must take as given the products delivered by its members. Under these conditions the total economic return may be less, and perhaps much less, than if lines of authority are instituted to facilitate production and marketing coordination.

Although cooperatives have been prominent in the development of better marketing procedures and facilities, the problems facing them today require more than adjustment of packing, processing, and selling methods. Providing product