2281

FOOD ENGINEERING
REPRINT

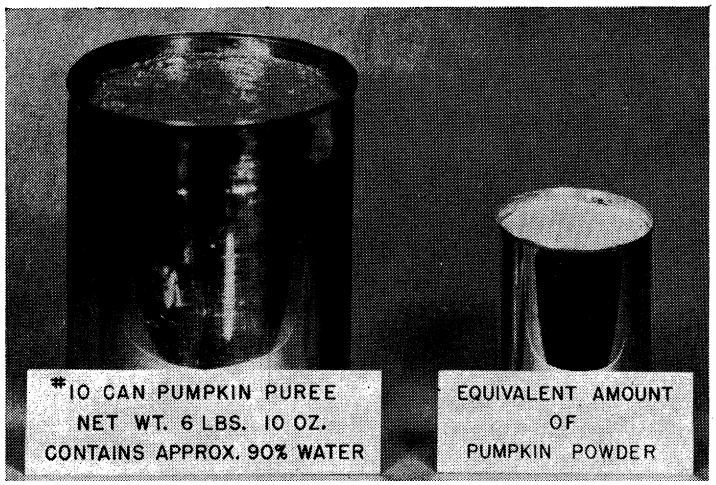

FIG. 1 — EQUIVALENT amounts show that canned pumpkin powder has one-seventh the weight and one-quarter the volume of regular puree, thus offering big savings in shipping, handling, and storage costs.

Making Pumpkin Powder Can Be Profitable

Product's free-flowing nature, smaller volume and weight offer advantages to the processor, commercial baker, and consumer. Here is summary of operating costs and equipment

A PROCESS for preparing pure dehydrated pumpkin powder was described in FE (May '64, p. 107). Interest generated by this article has brought requests for additional information, including the costs of operating the process on a commercial scale.

Accordingly, a cost estimate is presented here, listing the processing equipment, capital investment, and working capital required; the various items of manufacturing cost; and the estimated factory selling price for pumpkin powder packed in No. 10 cans.

Figuring Selling Price

Since the canned powder has one-seventh the weight and one-quarter the volume of regular puree, it could show significant savings in shipping, handling, and storage costs. Its free-flowing nature as well as its small weight and volume offer convenience to the commercial baker. Fig. 1 shows the relative volumes of puree and powder.

For home use, the powder has been blended with spices and other dry ingredients to make a powdered pie mix that needs only the addition of water and eggs before baking.

To preserve flavor adequately during storage, the pure powder has been canned under nitrogen. Storage tests run for over a year at room temperature have shown that powder packed in this fashion retains its original flavor practically unchanged.

Selling price of the powder at the cannery is computed at $11.08 per case of six No. 10 cans holding 18 lb net, assuming a 12% return on fixed capital. For making pies, one case of powder is equivalent to about 4.08 cases of conventional puree. This takes into account the fact that canned puree contains about 10% pumpkin solids but the powdered product must be reconstituted to 11% solids if pies of the same consistency are to result.

Taking $2.75 as the average Middle Atlantic case price for puree, one case of powder (selling at $11.08) equals 4.08 x $2.75 or $11.22 worth of puree, F.O.B. cannery. Delivered prices, however, could show a wider spread. For example, assuming truck-load shipping to New York City from a distance of about 200 miles, hauling charges would increase the price of the powder by 11¢ per case to $11.19, while the equivalent 4.08 cases of wet puree would now cost $12.07 delivered.

For smaller shipments at higher unit rates, the spread is larger. Thus, in 6000-lb lots, the delivered prices at standard LTL shipping rates would be approximately $11.42 for the powder and $13.84 for equivalent wet puree. This differential amounts to $0.59 per case of wet puree, a substantial saving.

One 3-lb can of powder will make 24, 9-in. pies.

Assuming eight cuts per pie, the price of the pumpkin powder is thus equivalent to slightly less than one cent per serving.

Cost Details of Process

The flowsheet, Fig. 2, shows the processing steps in preparing powder. It is assumed that the processing facilities will be built as an addition to a plant already canning conventional pumpkin puree. Thus, a portion of the output of the conventional puree line serves as the input to the dehydration line.

To obtain satisfactory operation of the drum dryer, the puree is first evaporated from its normal level of 9-10% solids up to 21%, using jacketed open kettles with scraper-type agitators. During the evaporation a small amount of a solution of Na_2SO_3 and $NaHSO_3$ is added to the kettle intermittently to help prevent darkening of the puree, with a total addition of 3600 ppm of equivalent SO_2. Most of this is lost in the process so that only about 250-500 ppm remain in the dry product.

After concentration, the puree is pumped to a gravity feed tank over the dryer. From the dryer, the coarsely-broken thin sheet is elevated into a hammermill-type comminuter where it is ground to pass through a 1/32-in. perforated screen. The powder is then conveyed to the feed hopper of the canning machine.

Filling into No. 10 cans to a net weight of 3 lb, sealing under nitrogen, labeling, packing six cans to a carton, palletizing and warehousing complete the process.

Capacity of the plant depends on the number and size of drum dryers. For this calculation, a single dryer of the largest commercial size was chosen. The operating season is assumed to consist of 45 days, with operations on a three-shift, round-the-clock basis.

The plant requires about 3650 lb per hour of pumpkin puree at 10% solids as feed to the kettles. Daily output, assuming 23-hr production with an hour downtime for cleanup and maintenance, will be 8310 lb of powder at 2% moisture, packed in No. 10 cans. That amounts to 2770 cans per day or 462 cases of 6 cans each. Seasonal production would be 20,775 cases.

Pumpkin puree is charged to the process at a cost of $2.77 per 100 lb. This figure was furnished as an average cost by a commercial packer of pumpkin puree.

Since the proposed plant is an adjunct to an existing plant, certain physical facilities are assumed to exist already and are not included in the list of capital cost items. However, a charge against the process is made for use of these facilities and appears under Operating Cost as "Rent." A separate table shows the facilities assumed available and the computation of the rental charge.

Addition of Potato Solids

Dehydrated pumpkin powder containing 20% by weight of white potato solids has also been produced. To make this product, potato flake fines obtainable

Financial Analysis

1. Annual Sales (45 days X $5113.58)	$230,111
2. Production Cost (3760.62 X 45 days)	169,228
3. Gross Annual Profit (Line 1 minus Line 2)	60,883
4. Administration, Research, Selling Cost, and Interest on Working Capital (45 days X sum of daily costs)	18,646
5. Annual Profit before Taxes (Line 3 minus Line 4)	42,237
6. Corporate Income Taxes (52% of Line 5)	21,963
7. Net Annual Earnings (Line 5 minus Line 6)	20,274
8. Earned on Fixed Capital (Line 7 X 100 divided by $169,000)	12.0%

Capital Costs

1. Process Equipment (See Equipment Summary)	$ 83,900
2. Erection of Equipment (17% of Item 1)	14,300
3. Instrumentation	1,800
4. Piping and Ductwork (10% of Item 1)	8,400
5. Erection of Piping and Ductwork (5% of Item 1)	4,200
6. Power, Installed (30 Kilowatts)	4,300
7. Insulation (Steam Lines)	600
8. Freight on Equipment (3% of Item 1)	2,500
9. Contingencies (10% of Total)	16,900
10. Contractor's Fee (4% of Total)	6,800
11. Engineering Fees (15% of Total)	25,300
12. Total Fixed Capital (Sum of Items 1 thru 11)	$169,000
13. Working Capital	
a. Maximum (at end of operating season when product inventory is high)	$150,000
b. Average over year	$75,000

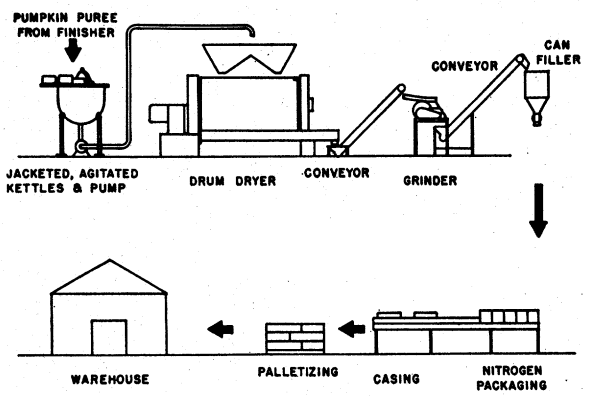

FIG. 2—FLOW SHEET shows process for preparing pur pumpkin powder from puree.

Summary of Operating Costs

	COST PER OPERATING DAY DOLLARS PER DAY	COST PER NO. 10 CAN OF PRODUCT (3 LB. NET) CENTS PER CAN
I. FACTORY MANUFACTURING COSTS		
A. Direct Production Costs		
1. Raw Materials		
Pumpkin puree - 83,950 lb. per day at $2.7673 per 100 lb.	2323.14	83.87
Sodium sulfite - 44.6 lb. at $8.50 per 100 lb.	3.79	0.14
Sodium bisulfite - 12.27 lb. at $6.00 per 100 lb.	0.74	0.03
TOTAL RAW MATERIALS	2327.67	84.03
2. Packaging Materials		
2770 No. 10 cans at 12.3¢	340.71	12.30
Cartons to hold 6 cans at 12¢	55.40	2.00
Labels - 2770 per day at $6.00/1000	16.62	0.60
Nitrogen gas for canning - 900 cu.ft. at $2.00/100 cu.ft.	18.00	0.65
TOTAL PACKAGING MATERIALS	470.73	15.55
3. Labor		
3 shifts per day, 5 men per shift	288.00	10.40
4. Indirect Labor		
Mechanic and Helper (⅓ time to dehydrated pumpkin)	20.00	0.72
Office Help	33.33	1.20
TOTAL INDIRECT LABOR	53.33	1.93
5. Maintenance and Repairs		
($169,000 x 5% x $\frac{45}{360}$ + $450) ÷ 45	38.16	1.38
6. Operating Supplies		
15% of Item No. 5	5.72	0.21
7. Utilities		
Steam - 98,700 lb. at 80¢/1000 lb.	78.92	2.85
Electricity - 765 kw-hr. at 1.0¢ per kw-hr.	7.65	0.28
Fuel (for fork lift truck)	1.00	0.04
Water - for cleanup - 3,000 gallons per day at 20¢ per 1000 gallons	0.60	0.02
TOTAL UTILITIES	88.17	3.18
DIRECT PRODUCTION COST (Sum of 1 to 7)	3231.78	116.67

	COST PER OPERATING DAY DOLLARS PER DAY	COST PER NO. 10 CAN OF PRODUCT (3 LB. NET) CENTS PER CAN
B. Fixed Charges		
8. Insurance		
1% of Total Fixed Capital per year	37.54	1.36
9. Taxes - Real Estate		
2% of Fixed Capital per year	75.09	2.71
10. Depreciation - Straight line based on 12-year life	312.87	11.29
11. Rent (See table below)	76.70	2.77
TOTAL FIXED CHARGES (Sum of 8 to 11)	502.20	18.13
C. Plant Overhead Costs		
12. Non-Wage Payments		
Social Security (3-1/8% on first $4800 per year)	10.67	0.39
Workmen's Compensation (1½% on Labor, ½% on Office)	4.02	0.15
Unemployment Insurance (1½% of Total payroll)	5.12	0.18
Vacation Time (2% of Total payroll)	6.83	0.25
TOTAL NON-WAGE PAYMENTS	26.64	0.93
TOTAL FACTORY MANUFACTURING COST (Sum of A, B, and C)	3760.62	135.76
II. GENERAL EXPENSE		
D. Interest on Working Capital (5% of $75,000.)	83.33	3.01
E. Research and Development (1½% of sales)	76.70	2.77
F. Administration and General (15% of sum of Labor, Supervision, Maintenance, and Supplies)	49.78	1.80
TOTAL GENERAL EXPENSES (Sum of D, E, and F)	209.81	7.57
III. COST TO MAKE (Sum of I and II)	3970.43	143.34
IV. SELLING COST (4% of sales)	204.54	7.38
V. PROFITS BEFORE INCOME TAX	938.61	33.88
VI. SELLING PRICE (Sum of III, IV, and V)	5113.58	184.61
Selling Price Per Case of six No. 10 cans: 6 X $1.846 = $11.08		

Rent Charged for Facilities Available

Item	Land	Site Preparation	Roads & Parking Areas	Processing Building	Warehouse Building	Boiler	Transportation Equipment	Office Equipment	Fire & Safety Equip.	Pallets for Warehousing
Size	Approx. 5000 sq. ft		13,600 sq.ft	22'x40' x15'high	40'x50' x15'high	4500 lb. per hr 125 psig	Fork Lift Truck			
Unit Price, dollars			6.00/ sq.yd.	12.00/ sq.ft	9.00/ sq.ft					
Initial Cost, dollars	400	500	9070	10,600	18,000	7,500	6,000	3,000	1,000	1,100
Charges, % per year										
Interest	5	5	5	5	5	5	5	5	5	5
Taxes	2	2	2	2	2	2	2	2	2	2
Insurance	0	0	0	1	1	1	1	1	1	1
Depreciation	0	0	5	3	3	4	10	8	8	25
Maintenance	5	-	5	4	4	6	5	3	3	5
Total, %	12	7	17	15	15	18	23	19	19	38
Annual Charges, dollars	48	35	1542	1590	2700	1350	1380	570	190	418
Charges per day, Dollars (300 days per year)			5.14			4.50	4.60	1.90		
Rent for Pumpkin Season (45 days), Dollars	40	35	231.30	1400	900	202.50	207.00	85.50	100	250

Total Annual Charges to Pumpkin Powder = $3451.30 - Rent per Operating Day = $3451.30 ÷ 45 = $76.70

Equipment Requirements and Costs

1. **JACKETED AGITATED KETTLES** (4 required) 200-gal (nominal) capacity of type 304 stainless steel, with double-motion agitators rotating at 25 rpm. Outer agitator scrapes kettle wall; 2-piece covers with vapor outlet duct; 4-in. bottom outlet with quick-opening valve with sanitary threads; carbon steel jacket rated for 90 psig working pressure; 2-HP agitator drive. $3800 each. . . . . **$15,200.**

2. **TRANSFER PUMP**—to pump concentrate from kettles to dryer feed tank. A single transfer pump is used for the four kettles; pump will be mounted on casters and switched to each kettle as needed, approx. once every 40 min; pump-out time per kettle about 5 min; all stainless construction; 3-HP motor with variable speed drive. . . . . **$3,400.**

3. **DRYER FEED TANK**—stainless steel, to receive batch of concentrate from kettle and hold it while slowly feeding by gravity to dryer; rectangular trough bottom; two quick-opening type discharge valves; two-piece loose lid. Volume 300 gal. . . . . **$1,100.**

4. **DRUM DRYER**—16-ft length by 5-ft diam with speed variable between 3½ to 5½ rpm; drum of fine-grained cast iron; equipped with four applicator rolls, discharge conveyor, and hood with blower; drive and auxiliary motors totaling about 11 HP. . . . . **$50,000.**

5. **ELEVATOR**—to lift about 370 lb/hr of broken sheet (dried pumpkin) from drum dryer up to feed hopper of comminuting machine; rubber belt conveyor approx. 12 ft long by 12 in. wide with cleats and side boards; ½-HP motor and drive. . . . . **$1,100.**

6. **GRINDER**—to comminute product; hammermill type with 1/32-in. perforated screen; stainless steel; 5-HP motor. . . . . **$3,000.**

7. **ELEVATOR**—to lift product from comminuter up to hopper of can filling machine; similar to item 5. . . . . **$1,100.**

8. **PACKAGING EQUIPMENT** to fill and seal No. 10 cans under nitrogen.

(A) hopper to hold powder.	$250.
(B) weighing feeder to measure a 3-lb charge to cans.	$500.
(C) roller conveyor to deliver cans to weighing station, lid clincher, and vacuum chamber.	$700.
(D) semi-automatic machine to clinch lids on cans but leave space for air to flow out and nitrogen to enter cans.	$2,250.
(E) vacuumizing and gassing chamber to pull vacuum of 29 in. of mercury and break vacuum with nitrogen, operating on a 2-min cycle.	$1,800.
(F) vacuum pump.	$1,300.
(G) semi-automatic can closer for final closing of lids.	$1,700.
(H) conveyor to carry cans from vacuum chamber to final can closer and to carton-filling station.	$500.

Total packaging equipment . . . . . $9,000.

TOTAL EQUIPMENT COST $83,900.

as a byproduct of potato flake manufacture are added to the puree in the kettles following evaporation. After blending, the mixture is processed to powder in the normal fashion. Addition of potato flake fines has these advantages:

It enables attaining the desired solids level in the puree with less evaporation, thus shortening cooking time in the kettles as well as lowering steam costs.

It permits increased drum rpm, higher dryer capacity, and increased plant throughput, by improving adhesion of the puree to the dry drum.

It yields a dried product of a slightly lighter color, which is desired by some pie bakers.

It reduces raw material cost, since potato solids cost less than half as much as pumpkin solids.

It provides an outlet for white potato flake fines.

Pies made with the 20% potato solids powder are indistinguishable by flavor and texture from those made with the pure powder.

With potato flake fines priced at 12¢ per lb, the raw material cost of powder containing 20% potato solids would be about 56¢ less per case (18 lb) of powder than for pure pumpkin powder. Further cost reduction due to increased plant throughput should make the total price differential about $1.00 per case.

Thus, pumpkin powder containing 20% potato solids might be delivered in New York City at $10.19 per case compared with the pure powder product at $11.19 and equivalent puree at $12.07. There would also be the convenience factor since only one case of the powdered product would have to be stored and handled in contrast to four cases of puree.

Evaluation of Products

Taste tests conducted in the Food Appraisal facilities of the Eastern Utilization Research and Development Division have shown that the powders make very acceptable pumpkin pies. Evaluation of the products by commercial bakers on a small scale is in progress. A limited quantity of the products is available as samples. These will be limited to potential producers or commercial users.

ACKNOWLEDGEMENT. *The authors gratefully acknowledge the help of Mrs. Florence Talley in evaluating the dried pumpkin in pies, and the furnishing of information on commercial canning of pumpkin by H. P. Cannon and Son, Inc., Bridgeville, Del.*