The Brine-Grading of Pigeonpeas

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INTRODUCTION

The effect of maturity on the quality of canned pigeonpeas was studied by Sánchez-Nieva (*1*)[2]. Various quality criteria such as drained weight, volume and viscosity of the brine, color and turbidity of the brine, and uniformity of color with respect to the predominance of the green pigment were found to depend on the maturity of the pigeonpeas processed. Since pigeonpeas at different stages of development are present throughout the crop, the harvested produce generally consists of a mixture of undeveloped, mature-green, and overripe yellow pigeonpeas. The proportion of each type in the product to be processed depends on the ability of the pickers properly to differentiate among the different stages of development at time of harvest. Because of this variation in maturity normally found in the pigeonpeas harvested for processing, quality control at the cannery constitutes a serious problem.

Brine-grading provides a means of separating a product like pigeonpeas into two groups of different maturity. The process is generally used in the canning or freezing of peas as a quality-control measure to separate the more tender from the more mature peas. The process of brine-grading and the equipment used have been described by Burton (*2*, *3*, *4*). The process consists of adding the product to be separated to a brine solution of known strength. The more tender peas float on the brine and the more mature sink. The best separation seems to be obtained when quality-grading blanched peas, since adhering bubbles in the unblanched product increase the buoyancy. By properly selecting the strength of the brine it is possible to separate the peas into groups such as Fancy, Choice, or Standard.

No information has been found in the literature on the brine-grading of pigeonpeas. The close similarity of pigeonpeas and peas led the authors to believe that brine-grading could also be used as a quality-grading procedure in the canning or freezing of pigeonpeas. In the canning or freezing of pigeonpeas it would be highly desirable to exclude the overripe yellow peas which are almost always present in the final product from the more

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[2] Italic numbers in parentheses refer to Literature Cited, p. 23.

tender green. Therefore, a study was conducted to determine whether it was possible to use brine-grading in the processing of pigeonpeas to improve product quality by separating the overmature yellow from the green peas.

MATERIALS AND METHODS

LABORATORY EXPERIMENTS

Brine-grading on a laboratory scale was conducted in 400-ml. beakers. About 400 ml. of brine of the desired specific gravity was added to each

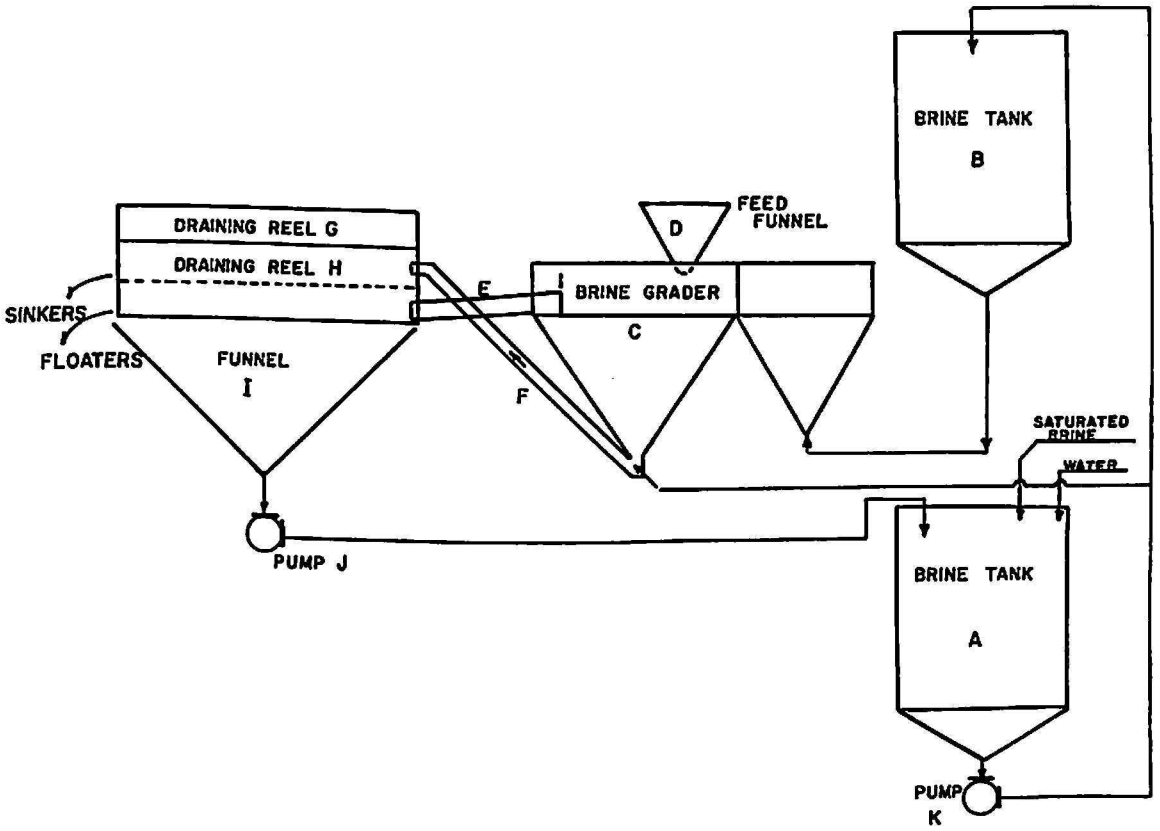

FIG. 1.—Pilot-plant equipment used in the brine-grading of pigeonpeas.

beaker; then 25 gm. of pigeonpeas were carefully added, and floaters and sinkers were separated 30 seconds later. Green and yellow peas in floaters and sinkers were separated by inspection, and the percentage of each within the two groups determined either by weight or by count.

PILOT-PLANT EXPERIMENTS

Pigeonpeas of the Kaki and Saragateado selections were steamed in the pods before shelling, or processed without steaming on a pilot-plant scale, as described by Sánchez-Nieva *et al.* (*5*). Brine-grading was carried out either before or after blanching, depending on the nature of the experiment. A homemade brine-grader of construction as shown in figure 1 was used.

The brine-grader was operated as follows: Brine of the desired strength is prepared in tank A. The strength of the brine in tank A is maintained constant throughout the run by means of a pneumatic density-controller which admits either water or concentrated brine to tank A to maintain the specific gravity of the brine within the desired limits. From tank A the brine is pumped with a centrifugal pump K to brine-tank B. The brine from tank B flows by gravity into the quality-separator C to avoid turbulence inside the separator. The pigeonpeas are fed through funnel D. The floaters discharge through duct E to a draining-reel. The sinkers are forced through F to a second draining-reel. A stream of brine is pumped through F, as indicated, to avoid clogging of tube F. The brine from the draining-reels is

TABLE 1.—*Separation of green and yellow pigeonpeas (percent) by brine-grading before and after blanching pigeonpeas shelled after steaming the pods*[1]

Characteristic	Run No.	Shelled peas	Brine-grading before blanching		Brine-grading after blanching	
			Floaters	Sinkers	Floaters	Sinkers
Alcohol-insoluble solids	1	27.3	25.3	30.6	25.5	31.4
	2	27.5	25.9	30.2	25.1	29.2
	3	25.6	22.9	28.6	24.1	29.0
Green peas	1	86.0	90.3	70.1	95.3	27.6
	2	81.0	94.3	63.9	97.2	51.2
	3	84.0	94.3	72.6	99.4	55.7
Overripe yellow peas	1	14.0	9.7	29.9	4.7	72.3
	2	19.0	5.7	36.1	2.8	48.8
	3	26.0	5.7	27.4	.6	45.4

[1] Specific gravity of brine 1.11 to 1.12.

collected in funnel I and pumped by pump J to brine-tank A. The draining-reels discharge either to a picking-table or to trays as desired. Floaters and sinkers were processed separately.

All canned samples were stored at room temperature (85° F.) before being analyzed or graded.

ANALYTICAL METHODS

Alcohol-insoluble solids were determined by the AOAC procedure (*6*) modified as follows: The sample for analysis was prepared by dispersing a known weight of pigeonpeas with an equal weight of water in a Waring blendor. About 15 gm. of this mixture are transferred to a 600-ml. beaker and extracted for 30 minutes with 80-percent alcohol. After the extraction was completed, the sample was filtered, the solids were washed with alco-

hol until the filtrate was free from coloring matter, and the washed solids were transferred to an aluminum dish and dried at 100° C. for 2 hours.

Starch was determined by the procedure described by Carter and Neubert (*7*) for the determination of starch in apples and modified for pigeonpeas by Sánchez-Nieva *et al.* (*8*).

The grade and score of the canned sample was based on three quality criteria: Color of the brine, turbidity of the brine, and percentage of yellow peas in the canned product. To determine score and grade, the following ranges of values were used for the three quality criteria measured:

Characteristic	*Range of values*	*Score*	*Grade*
Turbidity of brine (Klett-Summerson units)	220 or less	90–100	A
	221–300	89–80	B
	299–380	79–70	C
	381–460	69 or less	Substandard
Color of brine			
Hunter Units $\sqrt{T_o^2 + a^2 + b^2}$	38 or higher	90–100	A
	37–30	89–80	B
	29–22	79–70	C
	21 or less	69 or less	Substandard
Color of peas			
Percentage of yellow peas by count	0–10	100–90	A
	11–20	89–80	B
	21–30	79–70	C
	31 or more	69 or less	Substandard

RESULTS AND DISCUSSION

The results obtained when pigeonpeas steamed in the pods before shelling were brine-graded before and after blanching in brine of specific gravity 1.11 to 1.12 are given in table 1. The results show that brine-grading resulted in the separation of the pigeonpeas into two groups of different maturity. The floaters were considerably less developed than the sinkers, having an alcohol-insoluble solid content about 5-percent lower than the sinkers and about 2-percent lower than the ungraded product. Brine-grading, however, failed to completely separate the green from the yellow peas. The data in table 1 show that blanching before brine-grading resulted in a better separation of the green from the yellow peas, but even so, the floaters still contained yellow peas and the sinkers a high percentage of green peas.

The yields of floaters and sinkers from these experiments are given in table 2 and the quality of the product obtained when sinkers and floaters were canned are given in tables 3 and 4. When the pigeonpeas were brine-graded before blanching, from 45.9 to 67.1 pounds of floaters were obtained from every 100 pounds of peas processed. When the floaters were

canned, an A-grade product resulted. When the sinkers were canned, the quality of the product ranged from a B to a C grade.

When the blanched peas were brine-graded, the yield of floaters ranged from 71.12 to 92.58 pounds. When canned, the floaters were classified in the A grade and the sinkers as substandard products.

TABLE 2.—*Percentage of sinkers and floaters obtained when pigeonpeas shelled after steaming the pods were brine-graded before and after blanching*

Type	Run No.	Percentage by type after—	
		Brine-grading before blanching	Brine-grading after blanching
Floaters	1	67.1	92.6
	2	48.7	63.5
	3	45.9	71.1
Sinkers	1	38.8	7.4
	2	51.2	36.6
	3	54.1	28.9

TABLE 3.—*Quality of canned pigeonpeas brine-graded before blanching; pods steamed before shelling*

Characteristic	Floaters			Sinkers		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Brine turbidity..Clett-Summerson units	258	334	209	350	353	350
Color of brine..Hunter units	35.7	27.7	48.5	26.3	25.6	30.5
Yellow peas....percent	1.6	2.9	.05	30.0	29.2	23.5
Score	93.8	90.5	98.0	77.0	79.0	82.0
Grade	A	A	A	C	C	B

Similar results were obtained when peas shelled without steaming the pods were brine-graded before and after blanching. The data in table 5 show that brine-grading separated the pigeonpeas into two groups of different maturities, but failed to separate completely the yellow from the green pigeonpeas.

The percentages of sinkers and floaters obtained from these experiments are given in table 6. A higher percentage of floaters was obtained when the pigeonpeas were brine-graded before blanching. If the data in table 6 are compared with those in table 2 it can be observed that, when the pigeonpeas shelled by the steaming the pods were brine-graded, the higher yields

of floaters were obtained when brine-grading after blanching. Therefore, in order to obtain the higher yields of floaters, brine-grading should be carried after blanching when the pigeonpeas are steamed before shelling, and before blanching when the steaming treatment is omitted.

TABLE 4.—*Quality of canned pigeonpeas brine-graded after blanching; pods steamed before shelling*

Characteristic	Floaters			Sinkers		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Brine turbidity..Clett-Summerson units	313	256	239	575	430	395
Color of brine..Hunter units	29.6	37.4	44.4	16.7	19.9	24.4
Yellow peas....percent	5.8	2.8	2.14	93.0	42.4	34.6
Score	89.1	93.8	93.1	70.0	70.0	70.0
Grade	B	A	A	S	S	S

TABLE 5.—*Separation of green and yellow pigeonpeas, in percentage, by brine-grading before and after blanching pigeonpeas shelled without steaming the pods*[1]

Characteristic	Run No.	Shelled peas	Brine-grading before blanching		Brine-grading after blanching	
			Floaters	Sinkers	Floaters	Sinkers
Alcohol-insoluble solids	1	25.3	25.9	32.9	24.2	29.4
	2	25.6	26.0	29.9	23.2	27.4
	3	25.3	24.1	31.6	23.2	28.9
Green peas	1	84.9	90.2	81.4	95.6	54.6
	2	79.5	92.9	42.7	98.7	66.2
	3	79.7	95.9	50.5	95.6	61.2
Overripe yellow peas	1	15.0	9.8	18.6	4.4	45.4
	2	20.6	7.1	57.3	1.3	33.8
	3	23.3	4.1	49.5	4.4	38.8

[1] Specific gravity of brine 1.11 to 1.12.

The quality of the canned floaters and sinkers from the experiments described above are given in tables 7 and 8. When the floaters were canned, A-grade products were obtained, no matter whether brine-grading was carried out before or after blanching. Canning of the sinkers resulted in substandard products.

The results of these experiments show that brine-grading of pigeonpeas can separate the raw peas into two portions of different maturity, but

TABLE 6.—*Percentage of sinkers and floaters obtained when pigeonpeas shelled without steaming the pods were brine-graded before and after blanching*

Type	Run No.	Percentage by type	
		Brine-grading before blanching	Brine-grading after blanching
Floaters	1	90.6	80.4
	2	61.2	40.0
	3	72.8	56.4
Sinkers	1	9.4	19.6
	2	38.8	60.0
	3	27.2	43.6

TABLE 7.—*Quality of canned pigeonpeas brine-graded after blanching; pods shelled without steaming*

Characteristic	Floaters			Sinkers		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Brine turbidity..Clett-Summerson units	378	358	289	590	490	315
Color of brine..Hunter units	24.4	20.7	37.5	15.5	17.5	31.0
Yellow peas....percent	2.4	.6	2.6	41.5	42.0	37.8
Score	94.6	94.4	97.1	71.0	70.0	77.3
Grade	A	A	A	S	S	S

TABLE 8.—*Quality of canned pigeonpeas brine-graded before blanching; pods shelled without steaming*

Characteristic	Floaters			Sinkers		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Brine turbidity..Clett-Summerson units	457	321	265	620	389	328
Color of brine..Hunter units	21.6	28.6	39.4	16.5	25.6	34.9
Yellow peas....percent	4.9	4.1	2.6	84.3	48.0	45.9
Score	92	96	98	74	74.5	77
Grade	A	A	A	S	S	S

fail to separate the overripe yellow peas completely from the more tender green ones. The quality of the floaters is far superior to the quality of the sinkers. In most of the experiments which were carried out the canned sinkers were classified as substandard. Since a high percentage of sinkers

was always obtained, brine-grading, if used commercially, would result in a loss to the processor since the high percentage of sinkers obtained would appreciably reduce the yield of marketable product.

TABLE 9.—*Flotation characteristics of unblanched and blanched pigeonpeas of the Kaki selection in brines of specific gravities ranging from 1.09 to 1.14*

Specific gravity of brine	Percentage floaters by type			
	Green peas as percentage of total green in sample	Yellow peas as percentage of total yellow in sample	Percentage floaters	
			Green	Yellow
Unblanched pigeonpeas				
1.09	84.0	42.0	66.7	33.3
1.10	96.0	60.0	61.5	38.5
1.11	100.0	94.0	51.5	48.5
1.12	100.0	96.0	51.0	49.0
1.13	100.0	98.0	50.5	49.5
1.14	100.0	100.0	50.0	50.0
Blanched pigeonpeas				
1.09	56.0	2	96.0	3.4
1.10	80.0	0	100.0	0
1.11	80.0	4	95.2	4.8
1.12	84.0	24	77.8	22.2
1.13	96.0	60	61.5	38.5
1.14	100.0	96	51.0	49.0

TABLE 10.—*Starch content of unblanched and blanched pigeonpeas separated into floaters and sinkers by brine-flotation*

Specific gravity of brine	Treatment	Percentage starch in type indicated			
		Floaters		Sinkers	
		Green peas	Yellow peas	Green peas	Yellow peas
1.09	Unblanched	9.8	16.5	16.3	18.5
1.12	Blanched	12.4	16.8	16.0	18.2

The failure of brine-grading completely to separate the yellow overmature from the more tender green peas suggests that, even though the yellow peas are more mature than the green, there must be in both groups pigeonpeas having similar specific gravities, thus making a clear-cut separation impossible.

When a mixture of unblanched green and yellow pigeonpeas containing 50 percent of each was brine-graded in brines of specific gravities ranging from 1.09 to 1.14, the separation being carried out in 400-ml. beakers, the results given in table 9 were obtained. These results show that in all of the brines used, both green and yellow peas separated out as floaters and sinkers, indicating the presence in each group of peas of different maturity, but of similar specific gravity.

When the green and yellow peas in two groups of floaters and sinkers were separated by hand and the starch determined, the results given in table 10 were obtained. The results show that the green peas which separated out as floaters were less developed than the yellow floaters, having a lower starch content. Similarly the green peas in the sinker group were less mature than the yellow peas, having also a lower starch content. Similar results were obtained with blanched peas.

The results of these experiments clearly suggest that the use of brine-grading as a quality-control procedure in the canning of pigeonpeas is of doubtful value. Since brine-grading will not separate the pigeonpeas effectively according to maturity, the best it can achieve is a separation into two groups of different maturity, but each consisting of a mixture of pigeonpeas at different stages of development.

SUMMARY

The possibility of using brine-grading to improve the quality of canned pigeonpeas by separating the overmature yellow from the more tender green pigeonpeas was investigated. The results obtained show that brine-grading separated pigeonpeas into two groups, floaters and sinkers, the floaters being less developed than the sinkers, which were the more mature, but failed completely to separate the overmature yellow peas from the green. Failure to separate the overmature yellow peas from the green occurred because green and overripe yellow pigeonpeas, although having a different starch content, apparently have similar specific gravity, and may float or sink together in a brine of any given specific gravity, making a clear-cut separation between the two groups impossible. The results from this work suggest that brine-grading is of doubtful value as a quality-control measure in the canning of pigeonpeas because a high percentage of sinkers is generally obtained, which, when canned, result either in a low-C grade or a substandard product.

RESUMEN

Se llevó a cabo un estudio para determinar hasta qué punto los gandures verdes pueden separarse de los maduros mediante el uso de la técnica' por la cual se separan los granos por flotación en salmueras con concentraciones definidas.

Los resultados obtenidos de este estudio indican que cuando se usa el procedimiento de clasificación por flotación en salmuera, es posible separar los gandures en dos porciones a saber: los que flotan y los que se hunden. La primera porción comprende los gandures más tiernos, y los más maduros la segunda. No fue posible, sin embargo, separar los verdes de los maduros.

El análisis químico de los granos verdes y amarillos maduros que se separaron en el mismo grupo, ya fueran los que flotaron o los que se hundieron, indicó que los granos amarillos estaban más maduros que los verdes.

El hecho de que no pudiera lograrse una separación de verdes y amarillos indica que, aún cuando haya una diferencia en el estado de madurez de estos granos, ambos tipos tienen una densidad similar, hundiéndose o flotando al mismo tiempo y haciendo así que la separación de ambos sea imposible por el método de flotación en salmuera.

Los datos obtenidos de este estudio indican que no es recomendable usar este procedimiento para clasificar los gandures según su madurez, pues tendría que descartarse gran parte del producto ya que éste, al enlatarse, resultaría de muy baja calidad.

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