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Low-Sodium Pickle Products for Modified Diets[1]

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Patients who are told to use sodium-restricted diets frequently have difficulty in following such a food regimen because of its "flat, bland, and tasteless" character. These authors suggest that acceptable low-sodium pickle products could be processed and, if available, would add appetite appeal to such dull diets.

CUCUMBER PICKLES and relishes are currently on the list of foods "not allowed on sodium-restricted diets" (1,2), because they contain 1.5 to 3.5 per cent sodium chloride. In recent years, low-sodium diets for hypertension, congestive heart failure, and diseases associated with the retention of extracellular fluid have been prescribed frequently. Patients restricted to a low-sodium diet for months or even years have often rejected large portions of their food because they say it is "flat, bland, and tasteless." Low food intakes resulting in weight loss complicate their medical problems and, in some cases, symptoms of malnutrition develop (2). The American Heart Association provides, for doctors, dietitians, and patients, several booklets on the importance of the sodium-restricted diet. Pickles prepared with sodium chloride are not allowed; yet food manufacturers of breads, cereals, milk products, peanut butter, mayonnaise, tomato products, canned vegetables, and soups have met the requirements for a salt-restricted diet (2).

Pickle products add zest, flavor, and palatability to a meal, thereby increasing the appetite. Over the past thirty years, cucumber pickles have made substantial gains in popularity. A good part of this increased use (annual consumption is about 7.2 lb. per capita)[3] is the result of the remarkable consumer acceptance of fresh-pack (pasteurized) pickle products (3). Unlike the salt-brine fermentation method, pasteurized pickles are made from fresh, green cucumbers that are packed in containers; covered with a liquor containing vinegar, 5 to 7.5 per cent sodium chloride, and seasonings; and sealed hermetically. They are preserved in the jars by heat-processing by steam or hot water. Since raw cucumbers are relatively low in sodium, containing from 0.9 to 6 mg. per 100 gm. (1,4,5), a formula could be readily selected for fresh-pack pickles that would meet the requirements for low-sodium diets.

In contrast, fully cured, commercially brined cucumbers (salt-stock pickles), that contain 16 to 18 per cent salt before the normal "desalting," are used in making what the industry calls "processed pickle products." Thus, to prepare low-sodium products from brine

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[3]Data from Pickle Packers International, Inc., St. Charles, Illinois.

TABLE 1 **Evaluation of salt-free whole sweet and whole dill pickles, processed with salt substitutes**

CUCUMBER PICKLE PRODUCT AND TREATMENT*	EQUILIBRATED BRINE		OVERALL ACCEPTABILITY RATING	PANEL'S REMARKS
	Sodium chloride	Potassium chloride		
Processed Whole Sweets				
	%	%		
No sodium chloride (control)	0.1	0.0	fair to good	slightly flat, acceptable
Sodium chloride, 2.50%	1.2	0.0	good	acceptable
Potassium chloride, 1.25%	0.1	0.7	good	acceptable
Potassium chloride, 2.50%	0.1	1.1	fair	slightly flat, bitter
Salt substitute, 2.50%†	0.1	1.0	fair	flat, bland
Processed Whole Dills				
No sodium chloride (control)	0.1	0.0	poor	very flat
Sodium chloride, 7.50%	3.2	0.0	good	acceptable
Potassium chloride, 3.75%	0.1	1.5	fair	slightly flat
Potassium chloride, 7.50%	0.1	3.1	fair	bitter
Salt substitute, 7.50%†	0.1	2.6	fair	bitter

*Treatment indicates % salt in the cover-liquor before equilibration with the stock. Final salt concentration is approximately 35% to 40% of the amounts indicated. A product containing 0.1% sodium chloride is equivalent to approximately 40 mg. sodium per 100 gm.

†"Diasal"®. Content: potassium chloride and glutamic acid.

stock, the processor would need to desalt the solution almost entirely rather than use the normal 3 to 4 per cent salt content which is the usual practice. The processed pickles, at this point, are made into various staple pickle items: sweets, sours, dills, mixed pickles, hamburger slices, sweet dill spears, and various relishes. Rohrkaste described (6) a process for making low-sodium pickles and relishes by substituting sugar for salt in the fermentation solution. This procedure is unacceptable because of the development of undesirable yeasts and other gas-forming microorganisms which result in spoilage.

This study was undertaken after consultation with hospital dietitians who expressed a need for pickles with low-sodium content which would be acceptable for sodium-restricted diets.

Procedure

The low-sodium test pickles consisted of five to seven treatments of (a) whole sweet and dill pickles from fermented salt-stock and (b) fresh-pack pasteurized sweet and dill spears.

PICKLES FROM FERMENTED STOCK

A 5-gal. lot of commercial brine-stock cucumbers (1-in. diameter) of excellent quality was selected for preparing the whole sweet and dill pickles. Before the stock was brought to the laboratory for testing, the cucumbers were pierced with needles (using a commercial machine which makes six to eight very small holes in each one). This procedure facilitates the desalting operation, reduces shriveling, and speeds the sugar penetration. The brine-stock pickles were desalted by a thorough washing followed by leaching in several changes of tap water until the last change of water, at equilibrium, contained less than 0.1 per cent sodium chloride. Forty, 1-pt. glass jars were hand-packed with the desalted pickles to approximately 65 per cent solids on a volume basis. Two cover-liquors, one for sweet and one for dill pickles, were selected from the regular formulas of the pickle company. The ingredients, such as spices listed by Wohl and Goodhart (2), were checked and found to be free of sodium. Ten treatments of four jars of each product were prepared by adding sodium chloride, potassium chloride, or a salt substitute[4] to cover-liquors in the amounts indicated in Table 1. The coded jars were closed with 70-mm. Twist-Off[5] vacuum caps and pasteurized in a hot-water bath to an internal temperature of 165°±1°F. for 15 min., and promptly cooled to below 90°F.

FRESH-PACK PICKLES

Freshly harvested cucumbers (SC-23 variety, 1.5-in. diameter) of excellent quality were thoroughly washed and cut lengthwise into five or six spears per cucumber. The spears were then hand-packed into ninety, 1-pt. glass jars to give a solids-to-liquid fill ratio of 65 to 35 per cent. Two commercial formulas, one for the sweet and the other for the dills (both checked for low-sodium and salt-free ingredients) were used as cover-liquors. Seven treatments, including regular sodium chloride, salt-free control, and five concentrations of potassium chloride, were prepared for six jars of each product. The treatments and different levels of potassium chloride added in the cover-liquor are listed in Table 2. The jars were coded, capped, placed in wire baskets, and pasteurized in a commercial steam unit to 165°±1°F. internal temperature and promptly cooled to below 90°F.

[4]Diasal®, E. Fougera and Company, Hicksville, New York.
[5]White Cap Company, Division of Continental Can Company, Chicago.

TABLE 2 **Evaluation of fresh-pack, sweet cucumber spears, and dill spears with potassium chloride substituted for sodium chloride**

CUCUMBER PICKLE PRODUCT AND TREATMENT*	EQUILIBRATED BRINE		AVERAGE NUMERICAL RATING†				PANEL's REMARKS
	Sodium chloride	Potassium chloride	Appearance	Texture	Flavor	Overall acceptability	
			Sweet Spears				
	%	%					
Sodium chloride control, 3%	1.1	0.0	8.2	7.9	8.2	7.8	good, acceptable
No sodium chloride control	0.0	0.0	7.1	7.6	6.2	6.7	good, acceptable
Potassium chloride							
1%	0.0	0.4	7.4	7.6	6.7	6.7	good, acceptable
2%	0.0	0.7	7.2	8.0	7.3	7.5	good, acceptable
3%	0.0	1.1	6.9	7.4	6.5	6.6	fair, slightly bitter
4%	0.0	1.4	6.1	6.9	4.7	4.9	poor, bitter
5%	0.0	2.0	6.2	5.9	5.9	6.1	poor, very bitter
			Dill Spears				
Sodium chloride control, 5%	1.7	0.0	7.4	7.5	6.9	6.7	good, acceptable
No sodium chloride	0.0	0.0	6.7	6.7	3.8	4.3	poor, very flat
Potassium chloride							
2%	0.0	0.7	6.7	6.2	4.2	4.3	poor, slightly flat
4%	0.0	1.5	6.3	6.6	5.1	5.0	fair, questionable acceptability
6%	0.0	2.2	6.9	6.2	3.8	4.0	not acceptable, very bitter
8%	0.0	3.1	6.7	6.1	3.9	4.0	not acceptable, very bitter
10%	0.0	3.9	6.6	5.6	3.1	2.9	not acceptable, very bitter

*See footnote, Table 1.
†Rating scale: 1 and 2 = barely or not acceptable; 3-4 = poor; 5-6 = fair; 7-8 = good; and 9-10 = excellent.

CHEMICAL ANALYSES AND TASTE EVALUATIONS

Acetic acid, *pH*, sodium chloride (per cent weight per volume) (7,8), and sugar (9) were determined on the cover-liquors and on the different product liquors after equilibration according to published methods. Potassium chloride (per cent weight per volume) content of the equilibrated product liquor was determined by silver nitrate titration with dichlorofluorescein as the indicator (7).

After approximately six months' storage at room temperature, coded samples were evaluated for quality by two panels of judges (total of fifteen members) who rated each sample on appearance, flavor, texture, and overall acceptability. In each category, the judges used a rating scale of one to ten as follows: 1 and 2 = barely or not acceptable; 3 and 4 = poor; 5 and 6 = fair; 7 and 8 = good; and 9 and 10 = excellent.

Results and Discussion

Chemical analyses (acetic acid, *pH*, sugar, and sodium chloride) of the four cover-liquors, prepared at the pickle company from standard formulas, are shown in Table 3. The sodium chloride of each one was less than 0.01 per cent; in the manufacture of low-sodium pickles, it is this ingredient that must be closely controlled. The analyses of the equilibrated product liquors are also shown in Table 3. The final acetic acid, *pH*, and sugar contents were not influenced greatly by the addition of sodium chloride or potassium chloride to formulate each treatment.

TABLE 3 **Chemical analyses of the pickle cover-liquors and of the equilibrated pickle-product liquors**

CUCUMBER PICKLE PRODUCT	COVER-LIQUOR				RANGE FOR PRODUCT-EQUILIBRATED LIQUOR*		
	Vinegar as acetic acid	pH	Sugar	Sodium chloride	Acetic acid	pH	Sugar
	%		%	%	%		%
Processed, whole sweets	2.47	2.80	68	<0.01	1.02–1.05	2.90–3.05	27–29
Processed, whole dills	1.68	2.80	0	<0.01	0.72–0.77	3.01–3.20	00–00
Fresh-pack, sweet spears	2.42	2.25	42	<0.01	0.87–0.98	3.55–3.65	12–15
Fresh-pack, dill spears	1.52	2.80	0	<0.01	0.51–0.57	3.70–4.00	1.0–1.2†

*Products Nos. 1 and 2, 5 treatments each; Nos. 3 and 4, 7 treatments each (see Tables 1 and 2).
†Natural sugars of fresh cucumbers.

The equalized sodium chloride and potassium chloride brine strengths of the four products by treatment are given in Tables 1 and 2. The 0.1 per cent sodium chloride content of the processed whole sweet and dill products (Table 1) accounts for about 40 to 50 mg. sodium per 100 gm. and would be acceptable in a restricted low-sodium diet. Fresh-pack pickles (Table 2) are made directly from fresh green cucumbers and, thus, contain no sodium chloride. In manufacturing low-sodium pickles, the advantages of fresh-pack rather than high-salt-content brine-stock processing has been discussed.

PICKLES FROM FERMENTED STOCK

The evaluation of these two products (five treatments each) is summarized in Table 1. The judges rated the appearance and texture as "good" for all treatments. The overall acceptability of the pickles for the different salt treatments was rated primarily on taste (flavor). The judges rated only two treatments (2.5 per cent sodium chloride and 1.25 per cent potassium chloride) of the whole sweet pickles as "good" and "acceptable." Apparently, the low level of potassium chloride substituted very well for sodium chloride; however, the higher level of potassium chloride, the salt-substitute, and the salt-free treatments were rated low because of bitterness or flatness. In rating the whole dill pickles, the judges reduced the overall acceptability of the potassium chloride and salt-substitute treatments to "fair," as compared with "good" for the regular sodium chloride product. The low level of potassium chloride gave a flat taste, and the high level was bitter. The expected saltiness of dill pickles, supplied by sodium chloride, may be difficult to replace by other salts, such as potassium chloride. Some masking of this bitterness may be possible by adding 1 to 3 per cent sugar (10) to the cover-brine or by using other flavoring ingredients, such as garlic.

FRESH-PACK PICKLES

The evaluation by the two panels of judges of these products (seven treatments each) is given in Table 2. The judges' ratings for the fresh-pack products paralleled closely those described above for the processed whole sweet and dill pickles. With potassium chloride substituted for sodium chloride, sweet pickles were more nearly acceptable than were the dill pickles. The appearance and texture of both products were acceptable for all treatments and were rated "fair" to "good." The replacement of sodium chloride by potassium chloride was definitely noticeable in the flavor category, particularly at higher concentrations. Fresh-pack sweet spears with 1, 2, or 3 per cent potassium chloride were considered "fair" to "good" in flavor and acceptable, yet these treatments were judged about one rating unit below that of the regular sodium chloride pack. The potassium chloride-treated dill spears were rated lower in each category than those with the sodium chloride treatment. The high levels of potassium chloride (6 per cent and above) were definitely bitter; levels of 2 per cent were flat; and 4 per cent was considered "fair." As with the processed dill, a small amount of sugar along with 3 to 4 per cent potassium chloride in the cover-brine may make a more acceptable product. Pangborn *et al.* have shown (10) that adding 1.5 to 2 per cent sugar to regular sodium chloride pack of processed dill pickles improved the flavor, texture, color, and overall acceptability.

Summary and Recommendations

Four pickle products, *whole sweet* and *whole dill* from commercial salt-stock and fresh-pack pasteurized *swe t spears* and *dill spears,* were evaluated for use in low-sodium diets by substituting potassium chloride for sodium chloride. The two sweet pickle products, containing low concentrations of potassium chloride, were almost as acceptable as the products containing sodium chloride. In contrast, the dill products containing potassium chloride, when compared with the sodium chloride treatment, were reduced in the overall acceptability rating from "good" to "poor."

To meet the dietary needs of a growing population of individuals who are restricted to low-sodium diets, this study indicates that manufacturers could make several acceptable pickle products. Sweet pickles, especially the fresh-pack or pasteurized products, with suitable labeling such as "packed salt-free," could be made available for both home and institutional use. It is hoped that the manufacturers who may decide to market low-sodium pickle products will determine the sodium content as frequently as necessary and include the content on the label. Two methods (1) for determining sodium in foods—gravimetric and flame photometric—are available on request from the Food and Drug Administration. If potassium chloride is added, this should also be on the label. Potassium chloride is listed by Food and Drug Administration as GRAS ("generally recognized as safe") (11). However, the quantity of this substance when added to pickles should not exceed the amount reasonably required to substitute for sodium chloride. The responsibility of labeling the pickle products and noting the addition of potassium chloride should rest with the pickle manufacturer on advice of state and federal regulatory agencies.

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