Table 3. Vitamin C content of boniatos produced during three seasons. Average of 4 replications.

Cultivar	Harvest Spring	Summer	Fall	Cultivar Mean
		mg/100g		
Red	26.4	33.5	26.6	28.8a[z]
White	26.4	30.4	23.8	26.9b
Five Fingers	24.4	27.4	23.6	25.1bc
Del Valle	26.4	21.3	—	23.8cd
Green Stem	23.3	18.3	25.4	22.3d
Rojo Blanco	21.3	15.2	24.8	20.4d
Harvest Mean	24.7	24.3	24.8	

[z]Mean separation between cultivars by Duncan's multiple range test, 5% level.

Table 4. Internal color of boniatos produced during three seasons. Average of 4 replications.

Cultivar	Harvest Spring	Summer	Fall	Cultivar Mean
		HCDM value L		
Red	60.4	67.0	58.2	61.9a[z]
Del Valle	54.9	67.7	—	61.3a
Green Stem	57.4	68.4	57.0	60.9a
White	57.0	66.3	58.5	60.6a
Five Fingers	55.3	64.3	59.4	59.7a
Rojo Blanco	37.6	60.4	58.3	52.1b
Harvest Mean	53.8c	65.7a	58.3b	

[z]Mean separation between cultivars and harvests by Duncan's multiple range test, 5% level.

Flesh color between cultivars was fairly uniform except the very dark roots of 'Rojo Blanco' obtained from the spring harvest. Roots of 'Rojo Blanco' from summer and fall harvests were only slightly darker than for the other cultivars.

External appearance is a very important factor in the acceptability of any cultivar. 'Rojo Blanco' has the most pleasing appearance because of the uniform shape and red skin of the roots. In comparison with the other cultivars tested, it more nearly approached the appearance of regular sweet potatoes. From the standpoint of internal quality, 'Rojo Blanco' should be improved so that internal qualities including solids, Vitamin C and color conform to the external appearance.

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SENSORY ACCEPTANCE OF TOMATO SALAD-TYPE YOGURT SYSTEMS FROM OILSEED/DAIRY COMBINATIONS

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Abstract. **Yogurt systems were prepared from whole milk fortified with oilseed protein (soy protein isolate or peanut flour) and from oilseed protein/nonfat dry milk blends. Nonfat dry milk replaced oilseed protein in control preparations. Unflavored; tomato and spice; tomato, spice and vegetable; and fruit flavored tomato and spice; tomato, spice and vegetable; and fruit flavored yogurt systems were compared by sensory evaluation. The effects of heat processing and homogenization on sensory acceptance and texture measurement of tomato flavored yogurt systems were evaluated. Addition of tomato flavoring improved the sensory flavor rating of oilseed fortified yogurt systems. Addition of diced cucumbers, celery and tomatoes to tomato flavored yogurt did not significantly affect preference ratings. Tomato and fruit flavored oilseed fortified yogurt systems were considered inferior to similarly flavored controls by difference analysis. Tomato flavored yogurt systems made from soy protein/nonfat milk blends received higher preference ratings than did soy protein fortified yogurt systems. Heat processing at 70C for 10 min and homogenization improved sensory acceptance of tomato flavored oilseed fortified yogurt systems. Soy protein fortified yogurt systems had higher objective texture values than did other yogurt systems evaluated. Reprocessing lowered objective texture values.**

Formulated oilseed/milk blends may be a vehicle for expanding the utilization of oilseed protein resources. However, certain flavor and texture limitations of oilseed proteins, make acceptance less than favorable (6, 9). Sensory acceptance of oilseed milks (3, 5, 8) and of oilseed/milk combinations (7) can be improved by lactic fermentation to yogurt-like systems and by selection of flavoring agents. However, the flavors used have been primarily limited to fruit flavorings.

Recent industrial trends in the use of yogurt in the formulation of low fat salad dressing (1) facilitate a wider

[1]Florida Agricultural Experiment Stations Journal Series No. 837.

variety of flavoring agents. Therefore, a salad type yogurt product conceivably may have greater potential in masking oilseed flavors than does the standard fruit flavored yogurt system.

In the present study, tomato salad type yogurt systems prepared from whole milk fortified with oilseed protein and from nonfat dry milk (NFDM)/oilseed protein blends were compared. The effects of increasing fat content and heat processing on product acceptance were also investigated.

Experimental

Oilseed fortified milk systems were prepared from raw whole milk fortified to 15.0% total solids with soy protein isolate (SPI, Cenpro G, Central Soya, Inc., Chicago, IL) or peanut flour (PF, Gold Kist, Inc., Atlanta, GA). Milk fortified to 15.0% total solids with NFDM served as the control. Blended systems were prepared by dry blending (1:1) NFDM with SPI or PF and made to 15.0% total solids with water. Reconstituted NFDM at 15.0% total solids served as the control.

Gelatin stabilizer (Dari Tech., Corp., Atlanta, GA) was added at a level of 0.1% in all milk systems. The milks were heated at 83C for 30 min and homogenized in a Gaulin 15 Mtwo stage homogenizer (2500 psi-stage 1, 1,000 psi-stage 2).

Yogurt preparation was by incubation with a 2.0% inoculum of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Microlife Technics, Inc., Sarasota, FL) at 45C. Incubation was continued until the pH approximated 4.3 and the yogurt was cooled to 4C.

Tomato flavoring (commercial tomato paste, Contadina Foods, Los Angeles, CA) was blended into the yogurt systems at a final concentration of 17%. Several spices at various levels were used in preliminary studies. These spices included: onion salt, garlic salt, oregano, coliander and Worchestershire sauce. The formulations presented in Table 1 were used in subsequent experiments. In fruit flavored yogurt systems, fruit flavoring was added at a level of 22%. The flavorings were natural fruit flavorings (Food Producers, Inc., Minneapolis, MN) as previously described (7). In reprocessed yogurt systems, yogurt and flavor ingredients were mixed and heated at 70C for 10 min followed by homogenization as described previously.

Table 1. Formulation of tomato yogurt systems.

Yogurt type	Ingredient	% Composition
Tomato salad	Tomato paste	17.00
	Onion salt	0.20
	Garlic salt	0.03
	Worchestershire sauce	0.50
Tomato/vegetable salad	Tomato paste	17.00
	Onion salt	0.20
	Garlic salt	0.03
	Worchester sauce	0.50
	Diced cucumbers	15.00
	Diced celery	10.00
	Diced tomatoes	15.00

Sensory evaluation was conducted using a 20-member untrained panel selected from laboratory personnel and and students. Samples were presented in random order. Evaluation was difference/preference analysis as described by Larmond (4). Difference/analysis data were assigned numerical values from 1 to 9 with "no difference between the sample and the control" equaling 5; "extremely better than control" equaling 9; and "extremely inferior to control" equaling 1. In the preference analysis, panelists were asked to evaluate appearance, flavor, and texture of the samples according to a 9 point modified hedonic scale (1 = extremely poor; 9 = excellent). Overall acceptance was evaluated according to the hedonic scale (1 = dislike extremely; 9 = like extremely).

Objective texture evaluation of yogurt systems was done on the Instron Universal Testing Instrument fitted with a cylindrical disc probe of 10.0 mm diameter. The probe was allowed to penetrate the yogurt structure at 4C at a rate of 2.0 cm/min to a depth of 6.0 cm. The work (gm cm) involved in the penetration was calculated from the area under force distance curves.

Data were subjected to the Student's t-test for significance.

Results and Discussion

Sensory preference ratings of unflavored, tomato flavored and tomato/vegetable flavored yogurt systems prepared from oilseed fortified milks are summarized in Table 2. Mean appearance ratings for all yogurts ranged from approximately "below good-above fair" (6.0) to "good" (7.0). Addition of tomato or tomato/vegetable flavor mixtures did not significantly affect appearance ratings. Mean texture ratings for all yogurts also approached a 7.0 while differences in texture ratings between control and oilseed fortified yogurts were not significant.

Unflavored yogurt systems from oilseed fortified milk were given lower flavor ratings than were unflavored control yogurts. Addition of tomato or tomato/vegetable improved the mean flavor scores of oilseed fortified yogurt systems to a rating similar to the control. Overall acceptability ratings followed a trend similar to flavor ratings. Flavored PF fortified yogurt systems were judged lower in flavor and overall acceptability by the authors than were similarly prepared controls and SPI fortified yogurt systems. This was not reflected in sensory panel data. Differences can be related to flavor differences between the SPI and PF preparations rather than to differences between the oil seeds themselves.

Table 2. Sensory preference ratings of unflavored, tomato flavored and tomato/vegetable flavored yogurt systems manufactured from oilseed protein fortified milk.

Sensory attribute	Control			Soybean			Peanut		
	U[z]	T[y]	TV[x]	U	T	TV	U	T	TV
Appearance	6.0a	6.7ab	6.8ab	7.4b	7.4b	6.9ab	6.6ab	7.3b	6.6ab
Texture	6.4c	6.9c	6.6c	6.8c	6.9c	7.1c	6.5c	6.6c	6.5c
Flavor	5.8de	6.6e	6.5e	4.9d	6.2e	6.2e	5.1d	5.5de	5.5de
Overall Acceptability	5.8fg	6.6f	6.4f	5.7fg	6.3f	6.2f	4.9g	5.3fg	5.4fg

[z]U = unflavored; [y]T = tomato and spices; [x]TV = tomato, spices and vegetables.
Means for each attribute followed by the same letter within rows are not different ($P<0.05$).

The SPI used was processed to minimize off flavor for dairy applications.

While favorable comments were received on the tomato/vegetable mixture, differences between the tomato and tomato/vegetable yogurt were not significant. Therefore, the vegetables were excluded in subsequent trials.

In previous experiments (7), fruit flavored yogurt systems prepared from oilseed fortified milk were compared. In this investigation the tomato flavored products were compared to a variety of fruit flavored oilseed fortified yogurt systems by degree of difference from appropriate control (Table 3). Since similar trends were observed for the fruit flavors investigated, only red cherry data are presented. Oilseed fortified systems were rated moderately to slightly inferior to similarly flavored yogurt controls. There were no apparent differences in acceptance of tomato and fruit flavors by this type of analysis. Comparing the 2 flavor systems by sensory preference evaluation yielded similar results. These data suggest that tomato flavor system offers no advantage in masking oilseed flavors in fortified yogurt systems.

Table 3. Sensory difference ratings[z] of tomato and fruit flavored yogurt systems manufactured from oilseed protein fortified milk.

Yogurt system	Sensory rating
Tomato	
Soybean	3.7a
Peanut	3.6a
Red Cherry	
Soybean	4.2a
Peanut	3.5a

[z]Different from control (9 = extremely better; 5 = no difference; 1 = extremely inferior).
Means followed by the same letter are not different ($P<0.05$).

From the data presented in Table 4, there is an apparent preference for yogurt prepared from SPI/NFDM blends as opposed to SPI fortified whole milk. Mean appearance, flavor and overall acceptability ratings for SPI/NFDM yogurts were significantly higher than that of SPI fortified yogurt systems. Similar results were not obtained in yogurt prepared from PF/NFDM blends in which the mean texture rating was lower than that of PF fortified yogurt systems.

Table 4. Sensory preference ratings of tomato flavored yogurt manufactured from oilseed protein formulated milk systems.

Sensory Attribute	Control		Soybean		Peanut	
	F[z]	B[y]	F	B	F	B
Appearance	6.4a	7.2b	6.7ab	8.0c	6.8ab	7.0ab
Texture	6.7d	6.7d	6.9de	7.4e	6.5d	5.9f
Flavor	6.7g	7.1g	5.7h	6.8g	5.4h	5.3h
Overall acceptability	6.6i	6.9i	5.7j	6.7i	5.3j	5.1j

[z]F = whole milk fortified to 15% total solids with nonfat dry milk, soy protein isolate, or peanut flour.
[y]B = nonfat dry milk blended 1:1 with soy protein isolate or peanut flour and formulated to 15% total solids.
Means for each attribute followed by the same letter within rows are not different ($P<0.05$).

Yogurt systems prepared from SPI/NFDM blends were thicker and more custard-like in appearance than were other yogurt preparations. This could be due to the level of soy protein in these blends. The effects of heating and protein concentration on viscosity and thickening ability of soy protein are well documented (2).

The effects of increasing fat content and heat processing on difference ratings of tomato flavored yogurt systems are shown in Table 5. Reprocessed tomato flavored oilseed fortified yogurt systems were rated very similar to controls by difference analysis. This difference rating was also significantly different from that *for normally processed* yogurt systems.

Table 5. Sensory difference ratings[z] of reprocessed[y] tomato flavored yogurt systems manufactured from fortified milk.

Yogurt systems	Sensory rating
Normal process	
Soybean	3.7a
Peanut	3.6a
Reprocessed	
Soybean	4.6b
Peanut	4.7b

[z]Difference from control (9 = extremely different; 5 = no difference; 1 = extremely inferior).
[y]Fortified with cream to 7.0% fat, heated at 70°C for 10 min. and rehomogenized.
Means followed by the same letter are not different ($P<0.05$).

The preference rating data summarized in Table 6 also reveal that the acceptance of oilseed fortified tomato yogurt was improved by reprocessing. The most dramatic improvement, however, was in appearance rating which approached "very good" (8.0) for reprocessed yogurt systems. The reprocessing resulted in improved flavor and overall acceptability ratings for SPI fortified yogurt systems while that of reprocessed PF fortified and control yogurt were not significantly improved. Although texture improvement as a result of reprocessing was noted by comments from panelists, differences in mean texture ratings between reprocessed and normally processed systems were not apparent.

Table 6. Sensory preference ratings of reprocessed tomato flavored yogurt system manufactured from fortified milk.

Sensory Attribute	Control		Soybean		Peanut	
	N[z]	R[y]	N	R	N	R
Appearance	6.4a	7.5b	6.7a	7.7b	6.8a	7.6b
Texture	6.7c	7.2c	6.9c	7.5c	6.5c	7.2c
Flavor	6.7e	7.1e	5.7f	6.8e	5.4f	5.8f
Overall acceptability	6.6g	7.0g	5.7h	6.9g	5.3j	5.9j

[z]N = normal processing.
[y]R = fortified with cream to 7.0% fat, heated at 70°C for 10 min. and rehomogenized.
Means for each attribute followed by the same letter within rows are not different ($P<0.05$).

The objective texture data summarized in Table 7 indicate that reprocessing decreases the strength of the yogurt gel structure as determined by resistance to penetration. These data also more adequately describe the more viscous nature of SPI fortified yogurt systems than do sensory data.

The sensory data presented are characterized by a high degree of variability making statistical inferences difficult. This is primarily because the panelists were untrained in yogurt evaluation and were not screened for their acceptance of tomato flavored yogurt. Conceivably, untrained

Table 7. Objective texture evaluation[z] of reprocessed[y] tomato flavored yogurt made from fortified milk systems.

	Control	Soybean	Peanut
Normal process	307.9a	363.7b	273.8c
Reprocessed	109.7d	289.9e	202.4f

[z]Work (gm cm) required to penetrate to a depth of 6 cm with a 10 mm probe on Instron.
[y]Fortified with cream to 7.0% fat, heated at 70°C for 10 min. and rehomogenized.
Means followed by the same letter are not different ($P<0.05$).

panels more accurately reflect the general consuming population than do selected trained sensory panels.

The data suggest that a heat processed tomato yogurt salad base may be a potential means of expanding utilization of oilseed proteins, especially soy protein. Considerable improvement and modification of peanut protein technology may be necessary before optimum acceptance of this protein in yogurt systems will be possible.

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EFFECT OF DUMP-TANK WATER TEMPERATURE ON THE INCIDENCE OF BACTERIAL SOFT ROT OF TOMATOES

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Abstract. **The incidence of bacterial soft rot in tomatoes was higher after immersion in contaminated dump-tank water at 90°F (32.2°C) than after immersion in contaminated water at 60°F (15.6°C). As the concentration of bacteria** (Erwinia carotovora **Jones) increased in the water, the incidence of subsequent decay of immersed tomatoes increased accordingly. Heating dump-tank and wash waters to 90°F not only wastes energy, but also increases the decay of tomatoes during their subsequent ripening and marketing.**

In Florida, mature-green tomatoes are transported from the field to the packinghouse in pallet bins and then dumped into large tanks of water that cushion their fall. The water in the dump-tank and the water used in the subsequent washing operation, if not properly treated to reduce bacterial contamination, can contaminate the tomatoes (1, 2, 3). Chlorine has been shown to be effective in reducing the incidence of bacterial soft rot in tomatoes when added to dump-tank and spray-washer waters in the recommended amounts (1, 2, 3).

Packinghouse operators maintain water at about 90°F (32.2°C) in both dump-tanks and spray-washers. This practice aims to increase washing efficiency and to prevent the cracking of skin caused by the water being at a temp lower than that of the tomatoes (4).

In one typical packinghouse, the spray-wash water, which is not recirculated, is heated by a gas hot-water heater rated at 5.0×10^5 Btu (1.265×10^5 kg-cal). Water temp in the dump-tank is maintained by a gas burner rated at 1.5×10^6 Btu (3.795×10^5 kg-cal). The heated exhaust gases pass through a 10-inch (25.4-cm) pipe submerged in the dump-tank that acts as a heat exchanger. When operating at full capacity, the 2 heaters use 20.5 gal (77.5 liters) of liquified petroleum gas per hr at a cost of about $9.25.

This study compares the rates of decay of tomatoes exposed to dump-tank water at 2 temps and 5 levels of bacterial contamination.

Materials and Methods

Mature-green 'Walter' tomatoes were obtained from 2 packinghouses in Ft. Pierce, 1 in Ruskin, and 2 in Immokalee. The tomatoes were collected from pallet bins as they came from the field (before they received any packinghouse treatment) and were brought to the U.S. Horticultural Research Laboratory in Orlando for postharvest treatment. The fruit from each packinghouse were graded to eliminate culls, randomly divided into 10 lots of 50 fruit each, held overnight at 70°F (21°C), and then treated as shown in Table 1.

Water temps were 90°F (32.2°C) or 60°F (15.6°C) in the laboratory dump-tank containing 75 gal (284 liters) of tapwater. Contamination was simulated by adding a suspension of *Erwinia carotovora* Jones, the cause of bacterial soft rot, at a concn of 1×10^8 cells/ml. The suspension was added in progressive increments to produce the 5 concns shown in Table 1. One lot of tomatoes from each packinghouse was exposed to each of the 10 treatments. Each lot

[1]Dr. Segall, formerly Research Plant Pathologist, ARS, USDA, Orlando, Florida, died August 1977.