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Comparative Cost and Quality Studies of Dehydrated Vegetables Versus Fresh Vegetables Used in Institutional Food Services

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COMPARATIVE COST AND QUALITY STUDIES OF DEHYDRATED VEGETABLES VERSUS FRESH VEGETABLES USED IN INSTITUTIONAL FOOD SERVICES

by

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ABSTRACT

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by

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Utah State University, 1969

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The cost of fresh and dehydrated vegetables was studied in terms of initial cost and labor cost. Three institution kitchens were used: Logan Church of Jesus Christ of Latter-day Saints Hospital, Logan Senior High School, and the High Rise Cafeteria at Utah State University. Beans, celery, onions, peas, green peppers, diced potatoes, shredded potatoes, sliced potatoes, and whipped potatoes were included in the research.

Fresh vegetables were found to have lower initial cost. Labor costs were lower for dehydrated vegetables. In the preparation of 25 pounds of vegetables the total cost of dehydrated vegetables was less than that of fresh vegetables. This cost difference continued to increase as the amount of fresh vegetables used increased.

Quality scores indicated that the potato products, green

peppers when served in a mixed dish, and onions when served in a mixed dish were the best accepted of the dehydrated products. Green beans were found to be an unacceptable product.

(75 pages)

INTRODUCTION

Because of the perishability of vegetables and the difficulty of maintaining their quality in quantity food service, new developments in the purchasing and use of vegetables are of major interest to the food service industry.

Convenience, quality control, reduced labor costs, waste control, cost control, and reduction of equipment necessary for preparation with the accompanying reduction of floor space needed for this equipment are reasons for the trend toward the use of convenience vegetables.

This trend in food service institutions seems to be an inevitable one. An example of this is the increased use of dehydrated potatoes. In 1960, 25 percent of all potatoes consumed were in the dehydrated form; it is predicted that by 1970, 50 percent of all potatoes will be dehydrated; and by 1975, the only fresh potatoes available will be for baking (Myers and Roehm, 1963). This increase in the use of dehydrated potatoes is an indication of the extent to which foods in general are moving toward the convenience form.

Dehydration is an important phase of convenience foods. The basic preparation is done by food manufacturers away from areas of high investment and overhead costs. Their personnel have been

trained to do a specific operation, avoiding inefficient preparation and an accompanying reduction of waste.

There are several questions which arise when a food service administrator considers whether to use dehydrated vegetables or fresh vegetables in an institution kitchen. Some of these considerations are the nutritive value, the cost of special equipment, the storage space required, the cost of initial purchase, the preparation time, the labor expended in preparation, and the acceptability of the product to the consumer.

Objectives

1. To determine the economic feasibility of the institutional use of dehydrated vegetables such as celery, green peppers, beans, onions, peas, and potatoes in terms of time, labor, and cost as compared with the use of fresh vegetables.

2. To determine the acceptability of dehydrated vegetables when served in the Logan City School Lunch Program, at the High Rise Dormitory Cafeteria at Utah State University, and at the Logan Church of Jesus Christ of Latter-day Saints Hospital.

Definition of Terms

For the purposes of this paper some liberties have been taken in the use of terms. A fresh vegetable was considered as being a vegetable that had not been altered from the condition of

its harvesting and packing for marketing. The term processed vegetable was used when referring to a vegetable which had been canned by a heat method or frozen and packaged in preparation for marketing. A dehydrated vegetable was defined as a vegetable from which the water had been removed by hot air, thereby reducing the growth of micro-organisms and enzymatic activity. These dehydrated vegetables were then packaged for marketing.

The total cost of fresh vegetables, processed vegetables, and dehydrated vegetables was determined from the initial cost, the time of preparation, and the wage per minute in each institution. Equipment costs and space allowances were not included in the cost computations, nor were the space requirements for storage of the different forms of vegetables included.

Limitation of Study

Limitations recognized as potential influences on the study were:

1. The data gathered were limited to the Logan, Utah, area and did not allow for generalizations.

2. The initial purchasing costs and wages per hour were specific to each institution.

3. The short interval of the study did not allow for variation in seasonal costs of fresh vegetables nor for variation in seasonal quality of fresh vegetable.

REVIEW OF LITERATURE

All literature reviewed emphasized the increased use of dehydrated vegetables and expressed an assumption of their ever increasing use in the future. Because the dehydrated vegetable processors are able to buy at the peak of harvest, their vegetables are superior in maturity, flavor, texture, and nutritive value to those bought in the fresh form on the market at a later time. Dehydrated vegetables produce standard products not influenced by season or length of storage.

A review of the literature revealed that several studies have been conducted concerning nutritional values of various dehydrated vegetables. Findings indicated that the only significant nutritional loss in dehydrated vegetables was ascorbic acid (Bring et al., 1963; Bring and Raab, 1964; Cording et al., 1961; Hanning and Mudambi, 1962; Myers and Roehm, 1963). Potatoes contain some ascorbic acid, but it is recognized by the school lunch system that potatoes are not a prime source of ascorbic acid. Therefore, this loss does not interfere with the classification of a Type A school lunch when dehydrated potatoes are served (Utah State Board of Education, Division of School Food Services, 1969). Other studies have failed to show significant nutritional changes in dehydrated

vegetables. Little difference was reported in the total beta-carotene content of fresh carrots and dehydrated carrots (Della Monica, 1965). During storage, chlorophyll degraded at about the same rate in freeze dried peas as in frozen peas, and ascorbic acid was lost more rapidly in freeze dried peas than in frozen peas (Neumann, 1965). No serious damage to the protein of any vegetable was found as a result of dehydration (de Groot, 1963). In contrast, there was a considerable decrease in the protein of green beans which had been canned.

Although there have been quite a few studies done on the nutritional qualities of dehydrated vegetables, little work has been done on the total cost of dehydrated vegetables and especially on the quality or acceptability of dehydrated vegetables to the consumer. The time, labor, and initial cost studies which were found compared dehydrated onions and potatoes with fresh onions and potatoes, but were limited to the specific geographical areas in which they were conducted (Anonymous, 1958, 1963, 1961). The initial cost of dehydrated vegetables and fresh vegetables and the wages of the personnel vary greatly. Results were also dependent on the general layout of the kitchen, the personnel, the equipment, and the preparation space. The purchase of special equipment was often necessitated by either the preparation of dehydrated vegetables or of fresh vegetables.

Most literature showed a decrease in the cost of labor but

not of initial purchase cost with the use of dehydrated vegetables. Garvey (1968) stated, however, that food service operators should expect more than just labor costs to be reduced. The manufacturers are developing their own ways of reducing their cost, and these savings will eventually be passed on to the food service operators in the form of lower initial cost.

There was a tremendous variation reported in the percentage of trimming loss of vegetables (McCaffrey, 1966; West and Wood, 1961). Season, growing conditions, variety of vegetable, length of storage, method of preparation, and what each individual worker considered waste, all influenced the percentage of waste of a vegetable.

Pre-processed vegetables were another form of vegetable used in institutions (McCaffrey, 1966). These vegetables have had varying amounts of peeling, trimming, and chopping performed before being delivered to the institution. However, pre-processed vegetables were not used, nor were they readily available, in the locality of this study.

METHOD

Institutions Studied

The research for this study was conducted during the months of February and March, 1969. Three institution kitchens were used: The Logan Church of Jesus Christ of Latter-day Saints Hospital, the Logan Senior High School, and the High Rise Dormitory Cafeteria at Utah State University. The Hospital served approximately 100 meals three times a day, the High School served approximately 500 meals once a day, and the High Rise Cafeteria served approximately 1,000 meals three times a day.

Selection of Vegetables

The fresh and dehydrated vegetables studied were purchased by each individual institution. No effort was made to use brands other than those normally used in each kitchen. The following dehydrated products were evaluated and compared with their fresh counterparts: green beans, chopped celery, chopped onions, green peas, green peppers, whipped potatoes, shredded potatoes, sliced potatoes, and diced potatoes. Canned green beans and frozen peas were compared with dehydrated green beans and dehydrated peas rather than with fresh green beans and fresh peas. These were the

forms of the two vegetables used in all three institutions. Dehydrated peas and carrots in cream sauce were studied, but there was no comparison made with the same product prepared with fresh peas and carrots. The total cost of dehydrated shredded hash browns was calculated, and taste panels compared their quality with fresh shredded hash browns. The total cost of fresh shredded hash browns was not calculated because this product was not prepared from fresh potatoes in any of the institutions; therefore, a time and labor study was not possible.

Cost of Vegetables

Initial cost

A comparative study of the initial cost of purchasing fresh vegetables with dehydrated vegetables was made. The prices paid were obtained from the invoices of each individual institution, and were calculated from the figures on the invoices for December, 1968, and January and February, 1969.

Trimming loss

To determine the percent trimming loss incurred in the preparation of fresh vegetables, the vegetables as purchased were weighed, then peeled and trimmed. Either the refuse or the trimmed product was weighed, and from these figures the calculations giving the total percent of trimming loss were made.

In some instances the vegetables used were in poor condition due to the season and resulting length of time they had been stored. Onions had softened, potatoes had rot in the center, and celery was hollow and pithy. Because of these conditions the percentage of waste was greater than that reported in some of the literature and probably greater than it would have been in other seasons of the year.

Labor cost

The average wage of each of the three institutions was used to determine the labor cost. The time of preparation was multiplied by the wage per minute at each institution to obtain the total labor cost. The wage scale used at the High Rise Cafeteria was $1.45 per hour or 2.4 cents per minute, at Logan High School $1.55 per hour or 2.6 cents per minute, and at the Hospital $1.75 per hour or 2.9 cents per minute.

The equipment in each institution varied. A potato peeler was used at the High Rise Cafeteria, where 500 pounds of potatoes were peeled each time whipped potatoes were served. A portable potato peeler was used at the High School, where 250 to 300 pounds of potatoes were peeled each time whipped potatoes were on the menu. At the Hospital dehydrated whipped potatoes were served, eliminating the need for a potato peeler. A vegetable chopper was used at the High Rise. This chopper was also used in salad making and in

other areas of food preparation. The High School used the mixer attachments to grind vegetables. The diced potatoes were prepared with a hand operated dicer, and the sliced potatoes were prepared with the slicing attachment of the mixer.

Several timings were made of the preparation of each vegetable. There were varying degrees of skill displayed by the workers at all institutions. None of the workers had been specifically trained for vegetable preparation. An attempt was made to time the preparation in a normal atmosphere. Only actual preparation time was used in the calculations. Soaking and cooking time was not included.

Total cost

The total cost of dehydrated vegetables, processed vegetables, and fresh vegetables was determined by adding the mean initial cost and the mean labor cost. In calculating the cost of whipped potatoes the cost of additional ingredients was included. The only products given to the school lunch program by the United States Department of Agriculture were included in this category.

Storage of Vegetables

The packing cases and bags in which both fresh vegetables and dehydrated vegetables were received were measured. From these measurements the cubic feet required to store 100 pounds of

each fresh vegetable and an equivalent 100 pounds of each dehydrated vegetable were calculated.

Equipment Used in Vegetable Preparation

A survey was made of any equipment which was used exclusively in the preparation of either fresh or dehydrated vegetables. A price was obtained for any equipment that could be eliminated by the use of either dehydrated vegetables or fresh vegetables. The amount of floor space occupied in the preparation area by this equipment was measured.

Quality of Vegetables

Taste panels were conducted for each dehydrated vegetable, processed vegetable, and fresh vegetable with nine to twelve panelists participating at each sampling. Each vegetable was sampled from one to three different times. The panelists consisted of the kitchen workers, the supervisors, the dietitians, and the investigator.

The vegetables were sampled just before the panelists' lunch. It was not possible to have the panelists separated from each other nor to eliminate the odors of other foods from the atmosphere. Some of the panelists were previously biased against dehydrated vegetables, and surprise was nearly always noted when they found they liked a dehydrated vegetable. One sample was placed in a

paper dish. After it was sampled, another sample was placed in the dish. An effort was made to have an independent judgment rather than a comparison of the vegetables.

A sample of the score sheet used for each vegetable is found in Figure 1 of the Appendix. Six characteristics were used to describe quality: size and shape, color, uniformity, odor, taste, and texture. Five word ratings (very good, good, fair, poor, and very poor) were provided to judge each characteristic with the judges marking their choice. A definition of each word rating was given at the bottom of each score sheet to help provide uniformity in judging. When determining the scores of each sheet, points were assigned to each word rating. Very good, the most desirable rating, received five points, and very poor, the most undesirable rating, received one point. A weighted average was calculated for each quality of each vegetable. A space for general comments was also provided.

RESULTS AND DISCUSSION

Cost of Vegetables

Initial cost

The mean initial cost per pound of fresh and processed vegetables as taken from the individual institutions' invoices is given in Table 1. The mean initial cost of an equivalent untrimmed pound of dehydrated vegetables after reconstituting is shown in Table 2. The weight and yield of the containers of dehydrated vegetables are also shown in Table 2. The only two dehydrated vegetables whose initial cost was less than the initial cost of fresh vegetables were green peppers and whipped potatoes. Dehydrated green peppers were 2.4 cents less a pound at the Hospital and 5.4 cents less a pound at the High School. Dehydrated whipped potatoes were 0.6 cents less a pound at the Hospital, 0.3 cents less a pound at the High School, and 1.1 cents less a pound at the High Rise Cafeteria.

Trimming loss

The mean percent trimming loss of each fresh vegetable is shown in Table 3. The celery loss was 10 percent lower than that reported in the literature, and the loss of potatoes was 4 to 20

Table 1. Mean initial cost of one pound fresh and processed vegetables (in cents)

Institution	Vegetable	Mean initial cost
Logan L. D. S. Hospital	Beans, green (canned)	19.0
	Celery	15.0
	Onions	8.0
	Peas (frozen)	23.0
	Peppers, green	27.2
	Potatoes (#2 russets)	3.7
High Rise Cafeteria	Celery	8.3
	Onions	4.5
	Peppers, green	30.0
	Potatoes (#1 russets)	3.8
Logan Senior High School	Celery	9.3
	Onions	4.0
	Potatoes (#1 russets)	3.5

Table 2. Mean initial cost of one pound untrimmed dehydrated vegetables after reconstituting

Institution	Vegetable	Weight of container	Yield of container	Mean initial cost
		pounds	pounds	cents
Logan L. D. S.	Beans, green	1.50	14.00 (cooked)	29.60
	Celery	1.00	18.00	17.00
	Onions	15.00	120.00	9.60
	Peas	3.00	15.00 (shelled)	26.20
	Peas and carrots in cream sauce	3.75	15.00 (shelled)	31.60
	Peppers, green	1.00	22.00	24.60
	Potatoes, shredded	5.00	22.00	12.00
	Potatoes, sliced	2.00	12.50	7.83
	Potatoes, whipped	5.50	60.00	3.10
High Rise Cafeteria	Potatoes, whipped	5.50	60.00	3.10
Logan Senior High School	Celery	1.00	18.00	16.90
	Onions	14.00	120.00	8.00
	Peppers, green	1.00	22.00	24.60
	Potatoes, diced	2.25	16.00	4.70
	Potatoes, whipped	5.50	60.00	3.20

Table 3. Mean percent trimming loss incurred in the preparation of fresh vegetables (in percent)

Institution	Vegetable	Mean trimming loss
Logan L. D. S. Hospital	Celery	22.7
	Onions	13.1
	Peppers, green	26.0
	Potatoes, raw	29.0
	Potatoes, cooked	18.0
High Rise Cafeteria	Onions	25.0
	Potatoes, raw	36.4
Logan Senior High School	Celery	26.0
	Onions	15.8
	Potatoes, raw	46.8

percent higher than the literature reports. There were several reasons for this increased loss in potatoes. The quality of the potatoes was considered poor with nearly all potatoes having some brown rot in the center. This may have been due to the late season of the year. Inefficiency in the use of the potato peeler also increased waste. At the Hospital where there was no mechanical potato peeler, the waste was 29 percent, the minimum for potatoes in this study. At the two institutions which used potato peelers there was no effort made to leave the potatoes in the peeler a specific period of time. The potatoes were often left in the machine too long. Peeling irregularly shaped potatoes in the potato peeler also resulted in waste. These irregularly shaped potatoes were left in the peeler until they were peeled which meant the rounder, smoother potatoes were left in the peeler much too long.

The data in Table 4 show the cost of one prepared pound of each fresh vegetable which was calculated by using the mean initial cost and the percent trimming loss. The initial cost of dehydrated vegetables in Table 2 is equivalent to the cost of one prepared pound of fresh vegetables in Table 4, because there is no trimming loss involved in their preparation.

Labor cost

The mean time to prepare one pound of fresh vegetables is shown in Table 5. The mean time to prepare one pound of

Table 4. Mean cost of one prepared pound of fresh vegetables

Institution	Vegetable	Mean initial cost	Mean trimming loss	Mean cost
		cents	percent	cents
Logan L. D. S. Hospital	Beans, green (canned)	19.0	-	19.0
	Celery	15.0	23.0	18.5
	Onions	8.0	13.0	9.0
	Peas (frozen)	23.0	-	23.0
	Peppers, green	27.2	26.0	34.2
	Potatoes	3.7	29.0	4.8
High Rise Cafeteria	Onions	4.5	25.0	5.6
	Potatoes	3.8	36.0	5.2
Logan Senior High School	Celery	9.3	26.0	11.7
	Onions	4.0	16.0	4.6
	Potatoes	3.5	47.0	5.1

Table 5. Mean labor cost to prepare one pound of fresh vegetables as purchased

Institution	Vegetable	Mean preparation time	Mean wage	Mean cost
		minutes	cents/minute	cents/minute
Logan L. D. S. Hospital	Beans, green (canned)	0.14	2.9	0.40
	Celery, chopped	2.50	2.9	7.25
	Onions, chopped	3.97	2.9	11.51
	Peas (frozen)	0.42	2.9	1.22
	Peppers, green	19.50	2.9	56.55
High Rise Cafeteria	Onions, chopped	1.42	2.4	3.40
	Potatoes, whipped	0.96	2.4	2.30
Logan Senior High School	Celery, chopped	3.24	2.6	8.42
	Onions, chopped	2.67	2.6	6.94
	Potatoes, diced	0.96	2.6	2.50
	Potatoes, sliced	1.03	2.6	2.68
	Potatoes, whipped	0.83	2.6	2.16

dehydrated vegetables is shown in Table 6. Also shown in these Tables are the wages per minute at each institution. The average time of preparation multiplied by the wage per minute equals the labor cost of preparation of each vegetable. The mean labor cost for canned green beans was 0.12 cents less than for dehydrated green beans. The mean labor cost for frozen peas and dehydrated peas was equal. The labor cost of the dehydrated vegetables was less for all other vegetables.

Total cost

The data in Table 7 show that the mean initial cost, the mean cost of additional ingredients, and the labor cost were used to calculate the total cost per pound of fresh vegetables. The same information was used to calculate the total cost per pound of dehydrated vegetables shown in Table 8. The only products which required additional ingredients were whipped potatoes, both fresh and dehydrated. The cost of these additional ingredients was included in the total cost of the product. The United States Department of Agriculture subsidized the High School's butter and powdered milk. Four cents a pound was paid for butter, and ten cents a quart was paid for powdered milk. The cost of 2 percent milk at the High Rise Cafeteria was 90 cents per gallon; the cost of margarine was 0.157 cents per pound. No additional ingredients were used in whipped potatoes at the Hospital.

Table 6. Mean Labor cost to prepare one pound of reconstituted dehydrated vegetables

Institution	Vegetable	Mean preparation time	Mean wage	Mean cost
		minutes	cents/minute	cents/minute
Logan L. D. S. Hospital	Beans, green	0.18	2.9	0.52
	Celery, chopped	0.30	2.9	0.87
	Onions, chopped	0.66	2.9	1.91
	Peas	0.43	2.9	1.25
	Peas and carrots in cream sauce	1.80	2.9	5.22
	Peppers, green chopped	0.10	2.9	0.29
	Potatoes, shredded	2.66	2.9	7.71
	Potatoes, sliced	0.17	2.9	0.49
	Potatoes, whipped	0.13	2.9	0.49
High Rise Cafeteria	Potatoes, whipped	0.23	2.4	0.57
Logan Senior High School	Onions, chopped	0.50	2.6	1.30
	Peppers, green chopped	3.17	2.6	8.24
	Potatoes, diced	0.27	2.6	0.70
	Potatoes, whipped	0.19	2.6	0.50

Table 7. Mean total cost per pound of fresh and processed vegetables (in cents)

Institution	Vegetable	Mean initial cost	Mean cost of added ingredients	Mean labor cost	Mean total cost
Logan L. D. S. Hospital	Beans, green (canned)	19.0	-	0.4	19.4
	Celery	15.0	-	7.3	22.3
	Onions	8.0	-	11.5	19.5
	Peas (frozen)	23.0	-	1.2	24.2
	Peppers, green	27.2	-	56.6	83.8
	Potatoes, sliced	3.7	-	3.4	7.1
High Rise Cafeteria	Onions	4.5	-	3.4	7.9
	Potatoes, whipped	3.8	1.00	2.3	7.1
Logan Senior High School	Celery	9.3	-	8.4	17.7
	Onions	4.0	-	6.9	10.9
	Potatoes, shredded	3.5	-	2.5	6.0
	Potatoes, sliced	3.5	-	2.7	6.2
	Potatoes, whipped	3.5	0.15	2.2	5.9

Table 8. Mean total cost per pound of dehydrated vegetables (in cents)

Institution	Vegetable	Mean initial cost	Mean cost of added ingredients	Mean labor cost	Mean total cost
Logan L. D. S. Hospital	Beans, green	29.6	-	0.52	30.12
	Celery, chopped	17.0	-	0.87	17.87
	Onions, chopped	9.6	-	1.91	11.51
	Peas	26.2	-	1.25	27.45
	Peas and carrots in cream sauce	31.6	-	5.22	36.82
	Peppers, green chopped	24.6	-	0.29	24.89
	Potatoes, shredded	12.0	-	7.71	19.71
	Potatoes, sliced	7.8	-	0.49	8.29
	Potatoes, whipped	3.1	-	0.49	2.59
High Rise Cafeteria	Potatoes, whipped	2.35	2.13	0.57	5.05
Logan Senior High School	Onions, chopped	8.0	-	1.30	9.30
	Peppers, green chopped	24.6	-	8.24	32.84
	Potatoes, diced	4.7	-	0.70	5.40
	Potatoes, whipped	3.2	1.06	0.50	4.76

A comparison of the total cost per pound of dehydrated vegetables and fresh vegetables is given in Table 9. These total cost comparisons show:

The Hospital's cost of canned green beans was 10.7 cents or 36 percent less than the cost of dehydrated green beans.

The Hospital's cost of dehydrated chopped celery was 4.4 cents or 20 percent less than the cost of fresh chopped celery.

The Hospital's cost of dehydrated chopped onions was 8.0 cents or 41 percent less than the cost of fresh chopped onions. The High School's cost of dehydrated onions was 1.0 cents or 15 percent less than the cost of fresh chopped onions.

The Hospital's cost of frozen peas was 7.7 cents or 24 percent less than the cost of dehydrated peas.

The Hospital's cost of dehydrated chopped green peppers was 58.9 cents or 60 percent less than the cost of fresh chopped green peppers.

The High School's cost of dehydrated diced potatoes was 0.6 cents or 10 percent less than the cost of fresh diced potatoes.

The Hospital's cost of fresh sliced potatoes was 1.2 cents or 14 percent less than the cost of dehydrated sliced potatoes.

The High School's cost of dehydrated whipped potatoes was 1.1 cents or 19 percent less than the cost of fresh whipped potatoes, and the High Rise Cafeteria's cost of dehydrated whipped potatoes was 2.1 cents or 30 percent less than the cost of fresh whipped

Table 9. Comparison of mean total cost per pound of fresh, processed, and dehydrated vegetables (in cents)

Institution	Vegetable	Mean total cost		
		fresh	processed	dehydrated
Logan L. D. S. Hospital	Beans, green	-	19.4	30.1
	Celery, chopped	22.3	-	17.9
	Onions, chopped	19.5	-	11.5
	Peas	-	24.2	31.9
	Peppers, green chopped	83.8	-	24.9
	Potatoes, sliced	7.1	-	8.3
	Potatoes, shredded	-	-	19.7
	Potatoes, whipped	-	-	3.6
High Rise Cafeteria	Potatoes, whipped	7.1	-	5.0
Logan Senior High School	Onions, chopped	10.9	-	9.3
	Potatoes, diced	6.0	-	5.4
	Potatoes, whipped	5.9	-	4.8

potatoes.

A comparison of the total cost of 25 pounds of fresh vegetables and 25 pounds of dehydrated vegetables is given in Table 10. The results show:

The Hospital's cost of dehydrated green beans was $0.77 or 11 percent less than the cost of canned green beans.

The Hospital's cost of dehydrated chopped celery was $1.06 or 19 percent less than the cost of fresh chopped celery.

The Hospital's cost of dehydrated chopped onions was $1.97 or 40 percent less than the cost of fresh chopped onions. The High School's cost of dehydrated chopped onions was $0.36 or 14 percent less than the cost of fresh chopped onions.

The Hospital's cost of frozen peas was $1.13 or 13 percent less than the cost of dehydrated peas.

The Hospital's cost of dehydrated chopped green peppers was $14.69 or 71 percent less than the cost of fresh chopped green peppers.

The Hospital's cost of fresh sliced potatoes was $0.32 or 15 percent less than the cost of dehydrated sliced potatoes.

The High School's cost of dehydrated diced potatoes was $0.10 or 7 percent less than the cost of fresh diced potatoes.

The High School's cost of dehydrated whipped potatoes was $1.28 or 52 percent less than the cost of fresh whipped potatoes. The High Rise Cafeteria's cost of dehydrated whipped potatoes was

Table 10. Comparison of mean total cost per 25 pounds of fresh, processed, and dehydrated vegetables (in dollars)

Institution	Vegetable	Mean total cost		
		fresh	processed	dehydrated
Logan L. D. S. Hospital	Beans, green	-	7.21	6.44
	Celery, chopped	5.58	-	4.52
	Onions, chopped	4.88	-	2.91
	Peas	-	5.81	6.94
	Peas and carrots in cream sauce	-	-	8.19
	Peppers, green chopped	20.95	-	6.26
	Potatoes, sliced	1.77	-	2.09
	Potatoes, shredded	-	-	5.08
	Potatoes, whipped	-	-	.90
High Rise Cafeteria	Potatoes, whipped	1.78	-	1.26
	Onions, chopped	1.98	-	-
Logan Senior High School	Celery, chopped	4.43	-	-
	Onions, chopped	2.73	-	2.37
	Peppers, green chopped	-	-	8.29
	Potatoes, diced	1.50	-	1.40
	Potatoes, sliced	1.55	-	-
	Potatoes, whipped	2.48	-	1.20

$0.52 or 30 percent less than the cost of fresh whipped potatoes.

A subsequent projection of the preparation of 100 pounds of dehydrated vegetables and fresh vegetables would have again increased the total cost of fresh vegetables proportionately with the total cost of dehydrated vegetables increasing by their initial cost and very little, if any, additional labor cost. The difference between the cost of dehydrated vegetables and fresh vegetables would have been even more than at the 25-pound level.

There was an evident need for the dehydrated vegetables to be weighed or measured accurately before reconstituting in order to avoid waste. Guessing resulted in over production with consequent waste.

Cost is not the only influencing factor as to whether fresh or dehydrated vegetables should be used in an institution kitchen. At the High School kitchen availability of preparation space was an important factor. Oven and steam cooker space and preparation pans were often limited. In situations where a worker's time was needed elsewhere, the use of dehydrated vegetables would reduce his work load considerably and free him for other preparation. The time used for preparing large quantities of dehydrated vegetables increased very little from the time used to prepare one pound, while the time for preparing large quantities of fresh vegetables increased in the same proportion as the cost of the initial product.

Storage of Vegetables

The data in Table 11 show a comparison of the cubic feet needed to store 100 pounds of reconstituted dehydrated vegetables in the as-purchased form and of 100 pounds of processed and fresh vegetables as purchased. All fresh and processed vegetables required more space for storage than did the dehydrated vegetables. The results show:

The cubic feet required to store canned green beans was 2.2 times that of dehydrated green beans.

The cubic feet required to store fresh celery was 2.6 times that of dehydrated celery.

The cubic feet required to store fresh onions was 9.1 times that of dehydrated onions.

The cubic feet required to store frozen peas was 3.6 times that of dehydrated peas.

The cubic feet required to store fresh green peppers was 7.6 times that of dehydrated green peppers.

The cubic feet required to store fresh potatoes was 1.9 times that of dehydrated shredded potatoes.

The cubic feet required to store fresh potatoes was 2.7 times that of dehydrated sliced potatoes.

Table 11. Comparison of cubic feet required to store 100 pounds of fresh vegetables as purchased and an equivalent amount of processed and dehydrated vegetables (cubic feet)

Vegetable	Fresh	Processed	Dehydrated
Beans, green	-	2.53 (canned)	1.14
Celery	2.63	-	1.01
Onions	9.00	-	.99
Peas	-	3.50 (frozen)	1.01
Peas and carrots in cream sauce	-	-	1.01
Peppers, green	6.33	-	0.83
Potatoes, shredded	4.70	-	2.50
Potatoes, diced	4.70	-	1.13
Potatoes, sliced	4.70	-	1.72
Potatoes, whipped	4.70	-	0.28

The cubic feet required to store fresh potatoes was 16.8 times that of dehydrated whipped potatoes.

Fresh vegetable storage was limited to a few days, whereas the storage life of processed and dehydrated vegetables was over a year. This means that in programs such as the school lunch system these products could be kept from one school year to the next. Initial purchase costs could be reduced by buying dehydrated and processed vegetables in large quantities and storing them throughout the year, rather than purchasing small quantities of fresh vegetables often.

Equipment Used in Vegetable Preparation

The only piece of equipment which was used exclusively for the preparation of vegetables included in this research was a 60-pound Hobart Potato Peeler.[1] This 60-pound capacity vegetable peeler required four square feet of floor space for installation. The vegetable chopper used at the High Rise Cafeteria could not be considered because it was also used for preparation of other foods. Since the cost of equipment is incidental to this study, no further research was done.

Quality of Vegetables

Weighted averages for the six characteristics (size and shape,

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[1]This represented an initial investment of $701.25 for model number 6460T (Coleman, 1969).

color, uniformity, odor, taste, and texture) of each vegetable studied are shown in Table 12. The maximum score possible for each characteristic on any score sheet was five points, and one point was the minimum score possible. The data in Figure 2 through Figure 13 of the Appendix show graphically the distribution of weighted averages.

The color of reconstituted dehydrated green beans was much brighter than the color of canned green beans, but the judges did not associate this color with the usual color of green beans and therefore did not judge them as superior. The scores of all characteristics were lower for dehydrated green beans than for fresh green beans. Written comments indicated the taste was a little stronger in dehydrated green beans, and that the texture was watery and mushy. Comments and scores also indicated that it was an undesirable product and some said they would not eat this product if it were served to them.

The scores of fresh chopped celery indicated it was a much better product than dehydrated chopped celery. However, large pieces of celery were called for in chow mein, the dish used for sampling celery. These large pieces of celery provided a crunchy texture. It was not possible to duplicate these large pieces of celery when using dehydrated chopped celery.

Sautéed dehydrated chopped onions received scores slightly lower than sautéed fresh chopped onions. However, shrimp creole

Table 12. Weighted averages of scores[a] for fresh, processed, and dehydrated vegetables by taste panels

Vegetable	Form	Qualities					
		Size shape	Color	Uniformity	Odor	Flavor	Texture
Beans, green	canned	4.43	3.86	4.36	4.34	4.24	4.24
	dehy.	3.42	3.74	3.40	3.11	2.90	2.93
Celery, chopped (chow mein)	fresh	4.11	4.22	4.18	4.45	4.67	4.56
	dehy.	3.78	3.67	4.11	3.78	3.45	3.45
Onions, chopped (sautéed)	fresh	4.07	4.22	4.11	4.12	3.74	3.85
	dehy.	4.05	3.69	4.91	3.94	3.89	3.60
Onions, chopped (shrimp creole)	fresh	3.96	4.11	4.00	4.27	3.96	4.22
	dehy.	4.27	4.43	4.38	4.58	4.50	4.27
Peas	frozen	3.50	3.75	4.42	4.03	4.02	4.11
	dehy.	3.83	4.29	3.75	3.47	3.18	3.35
Peas and carrots in cream sauce	dehy.	4.10	4.40	4.00	4.00	3.90	3.70
Peppers, green (sautéed)	fresh	4.04	4.38	4.04	4.12	4.38	4.25
	dehy.	3.00	2.28	2.78	2.78	2.78	2.28
Peppers, green (fried rice)	fresh	4.44	4.67	4.44	4.44	4.67	4.56
	dehy.	4.44	4.29	4.44	4.44	4.67	4.44
Potatoes, shredded	fresh	3.45	3.09	3.37	3.91	3.23	3.82
	dehy.	4.60	4.50	4.50	4.10	4.10	4.10
Potatoes, sliced	fresh	4.20	4.00	4.10	4.10	4.10	4.10
	dehy.	4.00	4.10	4.10	4.10	3.80	3.90
Potatoes, diced	fresh	4.00	4.22	3.78	3.89	3.08	3.63
	dehy.	4.33	4.33	4.22	3.96	4.07	4.33
Potatoes, whipped	fresh	4.51	4.56	4.42	4.46	4.34	4.40
	dehy.	4.20	4.33	4.33	4.15	4.13	4.07

[a]Scores of 5 points=very good; 4 points=good; 3 points=fair; 2 points=poor; and 1 point=very poor.

prepared with dehydrated chopped onions received scores slightly higher than shrimp creole prepared with fresh chopped onions.

The reconstituted dehydrated peas were a very bright green color. Written comments on the score sheets indicated they were slightly tough and chewy, but the over-all product was acceptable. The peas sampled were reconstituted in a deep pan in the steam cooker. Perhaps reconstituting in a shallow pan would have provided better heat penetration. The same alteration in cooking method could have improved the unevenness in color which was reported in the frozen peas sampled.

The color of sautéed dehydrated chopped green peppers was a very olive green. The judges scored all other characteristics of dehydrated chopped green peppers lower than fresh chopped green peppers. The color of the dehydrated chopped green peppers seemed to influence the judges when scoring the other characteristics.

The dehydrated shredded potatoes were one of the best accepted products by the judges. The scores were higher for all characteristics of dehydrated shredded potatoes than for fresh shredded potatoes. The judges' comments were very favorable toward this product.

Written comments by the judges at the Hospital about whipped potatoes indicated that they were aware of the difference between dehydrated whipped potatoes and fresh whipped potatoes, but they did not necessarily prefer the fresh over the dehydrated even though

the scores were slightly higher for fresh whipped potatoes. At the High School there was a definite "cellar" taste in the fresh whipped potatoes, therefore the dehydrated whipped potatoes were preferable at this season of the year.

Neither the High School nor the High Rise Cafeteria had used dehydrated whipped potatoes except in small quantities after exhausting their supply of fresh whipped potatoes. Both institutions tried dehydrated whipped potatoes while this research was being done. There were no unfavorable comments from the students nor were there any increases in plate waste.

At the High School, different methods of reconstituting whipped dehydrated potatoes were tried, and the products were tasted. Even though the milk was included in the brand of dehydrated potatoes used by all three institutions, the use of part milk in reconstituting improved the flavor. Whipping for five minutes, as the directions on the can instructed rather than just mixing until the product was well moistened, increased the volume as well as reduced the graininess which resulted in an improved texture and an improved product.

SUMMARY AND CONCLUSIONS

The increasing cost of labor and raw materials has necessitated changes in the production of food within the food service industry. A review of literature indicated an increased use of convenience foods. Dehydration of vegetables is an important part of this revolution to convenience foods. Food service operators need information as to the economic implications of the use of dehydrated vegetables in their institutions. They also need an indication of how these dehydrated vegetables will ultimately be accepted by their clientele.

The purpose of this research was to make a comparative study of the total cost of fresh vegetables and dehydrated vegetables. A survey of the quality of these vegetables was also made. Canned green beans instead of fresh green beans were compared with dehydrated green beans, and frozen peas instead of fresh peas were compared with dehydrated peas.

To determine the total cost of fresh vegetables and dehydrated vegetables, the initial purchasing cost, the mean preparation time, the trimming loss, and the wage per minute in each of the three institutions studied were included. The amount of space needed for storage of both forms of vegetables was established. Score sheets were used by taste panels to determine quality. The kitchen workers,

supervisors, dietitians, and investigator served on the taste panels for both fresh and dehydrated vegetables.

Trimming losses were found to be generally higher than those reported in the literature, especially for potatoes. A comparison of the total cost of 25 pounds of fresh vegetables and 25 pounds of dehydrated vegetables showed that the dehydrated form was less expensive for the vegetables studied with two exceptions. Frozen peas were less expensive than dehydrated peas, and fresh sliced potatoes were less expensive than dehydrated sliced potatoes.

All dehydrated vegetables required less storage space than their fresh and processed counterparts. The period of time vegetables could be stored was much longer for the dehydrated form.

Results from the taste panels indicated that the dehydrated green beans were an unacceptable product. The flavor and texture scores were both in the poor category.

Fresh chopped celery sampled in chow mein was rated superior to dehydrated chopped celery. A recipe that did not call for as high a percentage of celery may have shown different results.

The scores for the flavor of sautéed dehydrated chopped onions were slightly higher than the scores for sautéed fresh chopped onions. The scores for shrimp creole prepared with dehydrated chopped onions were higher for all characteristics than for shrimp creole prepared with fresh chopped onions.

Frozen peas received higher scores for all characteristics

than for dehydrated peas. Sautéed chopped green peppers were preferred fresh, but no preference was indicated when sampled in fried rice.

Fresh sliced potato scores were slightly higher than the dehydrated sliced potato scores. Dehydrated shredded potato and dehydrated diced potato scores were higher than fresh shredded potato and fresh diced potato scores. These scores of whipped potatoes indicated a very slight preference for fresh whipped potatoes over dehydrated whipped potatoes.

In general, all dehydrated potato products and dehydrated chopped onions and chopped green peppers in mixed dishes were the best accepted of the vegetables studied in this research.

On the basis of the data presented in this investigation, the use of dehydrated vegetables should be seriously considered by food service operators.

Further studies are indicated. Specifically, one comparing different brands of various dehydrated vegetables, as well as one comparing different reconstituting methods, would contribute additional useful information to the use of dehydrated vegetables in food service institutions.

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APPENDIX

Laboratory:		Sample Number:		Date:	
SIZE AND SHAPE	very good	good	fair	poor	very poor
COLOR	very good	good	fair	poor	very poor
UNIFORMITY	very good	good	fair	poor	very poor
ODOR	very good	good	fair	poor	very poor
FLAVOR	very good	good	fair	poor	very poor
TEXTURE	very good	good	fair	poor	very poor
COMMENTS:					

Name of Judge

VERY GOOD: in all respects; you know of no improvement

GOOD: enjoyed it; minor improvement desirable

FAIR: could eat it without enthusiasm; improvement needed

POOR: edible, but that is all

VERY POOR: inedible

Figure 1. Score sheet for taste panels.

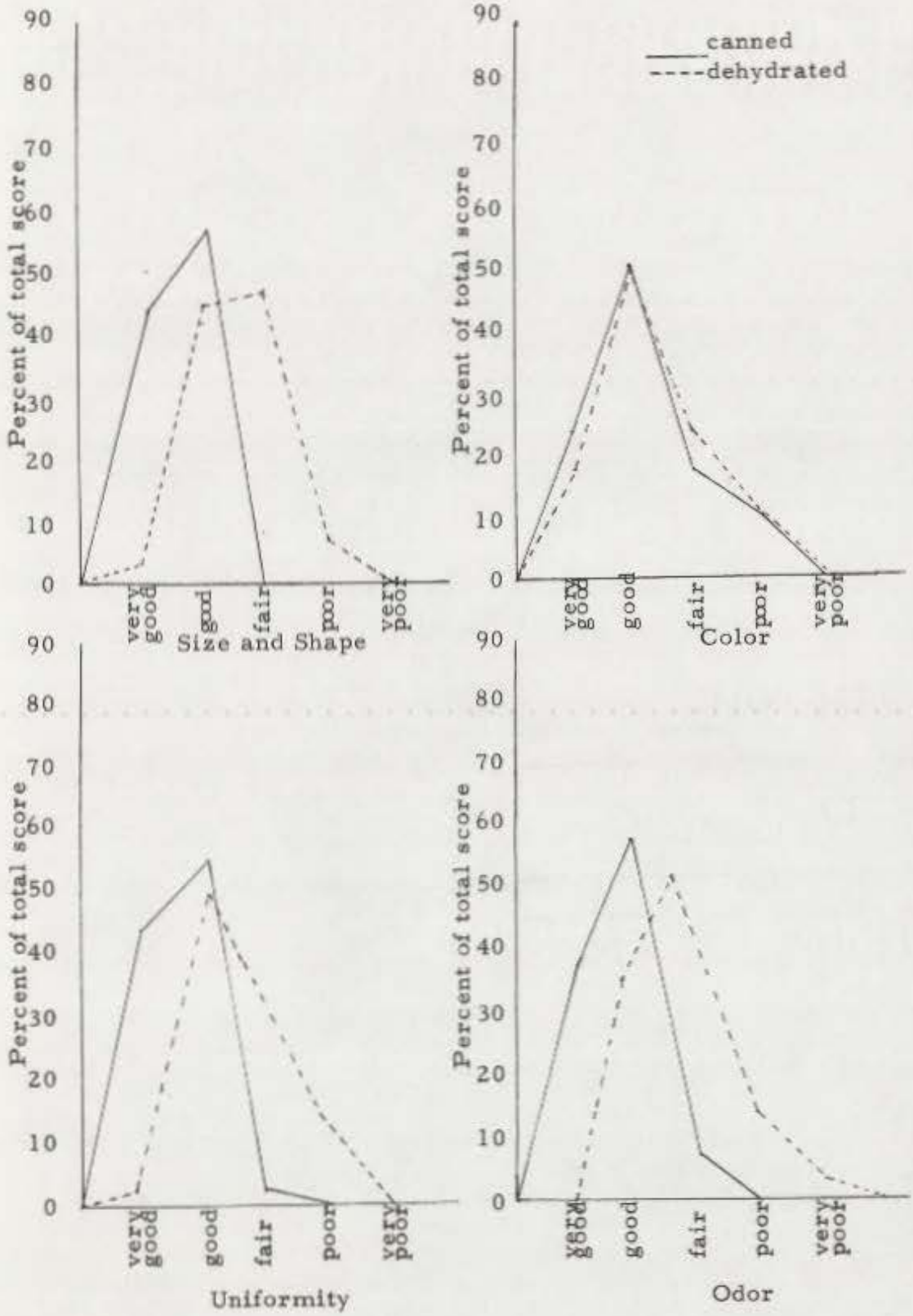
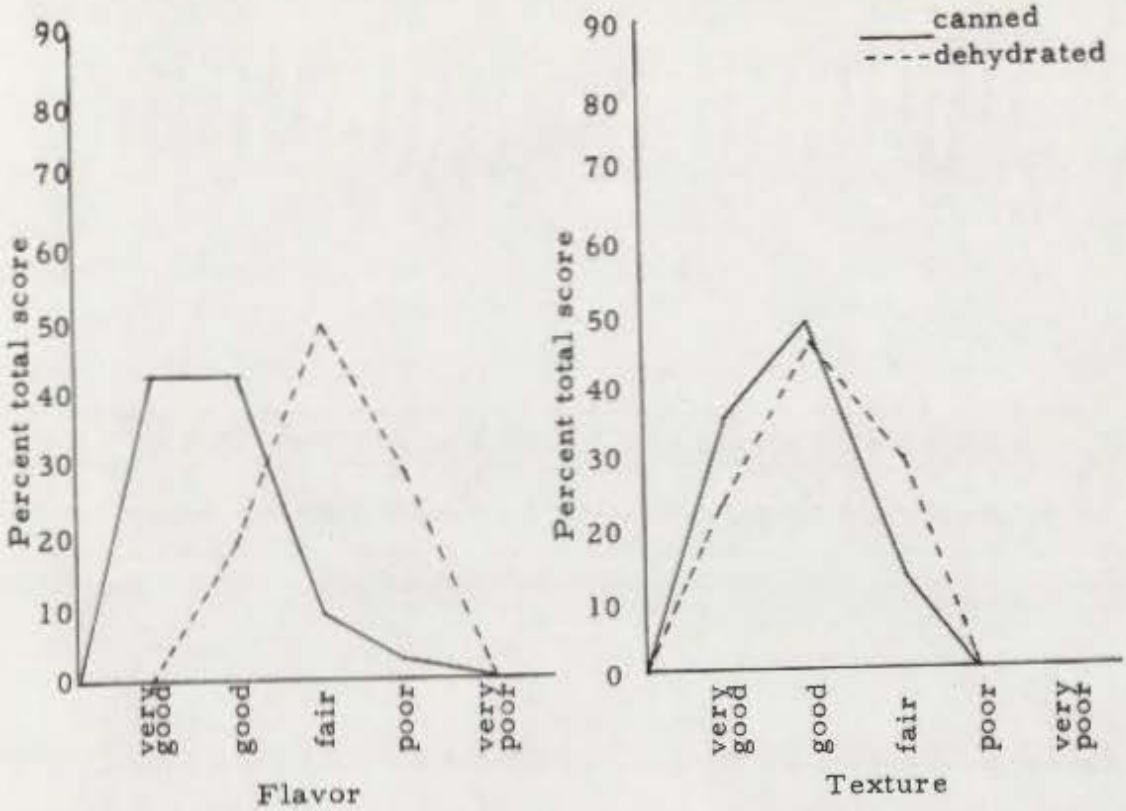


Figure 2. Graphs of weighted averages of taste panel scores for canned and dehydrated green beans.



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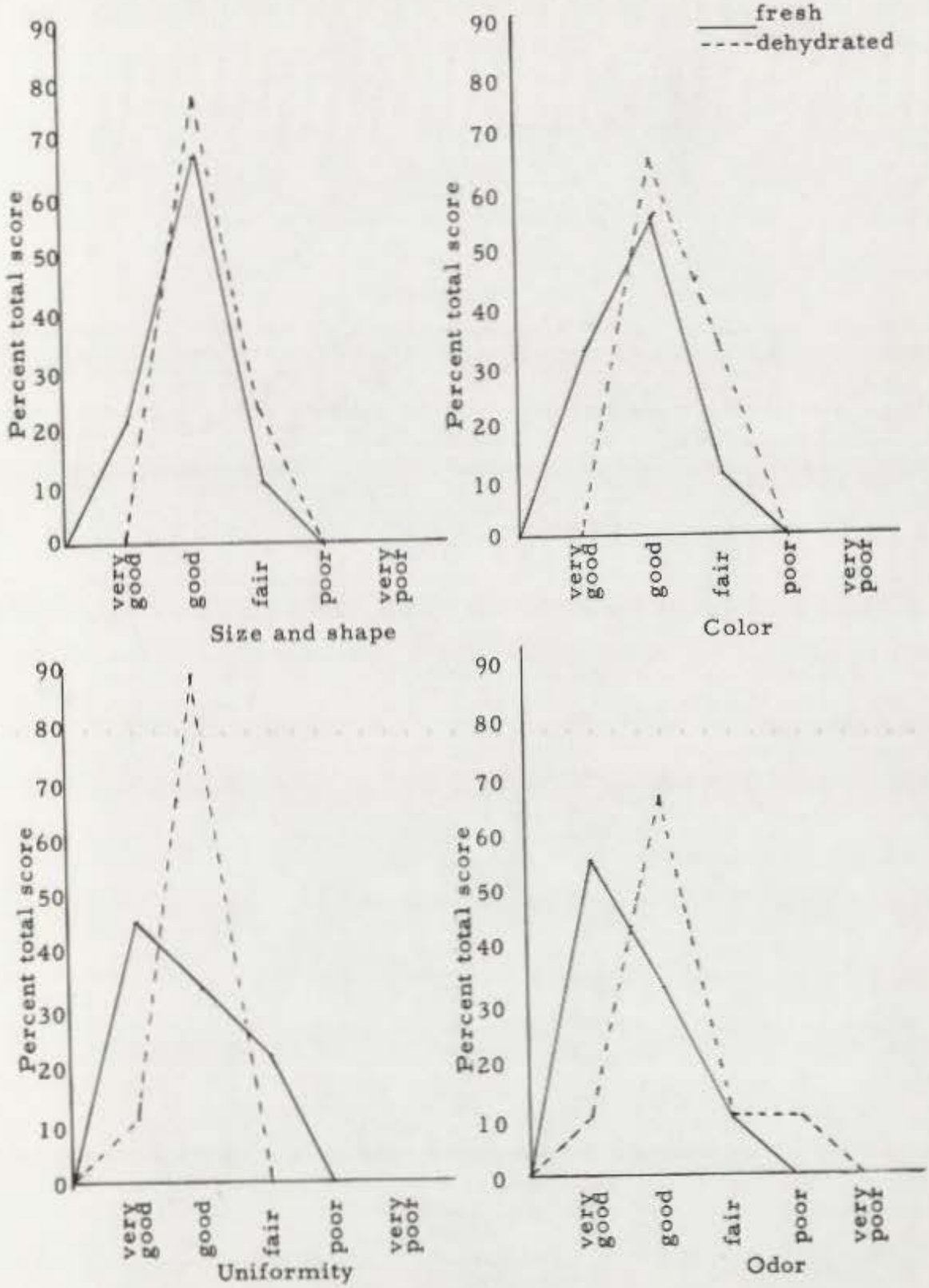
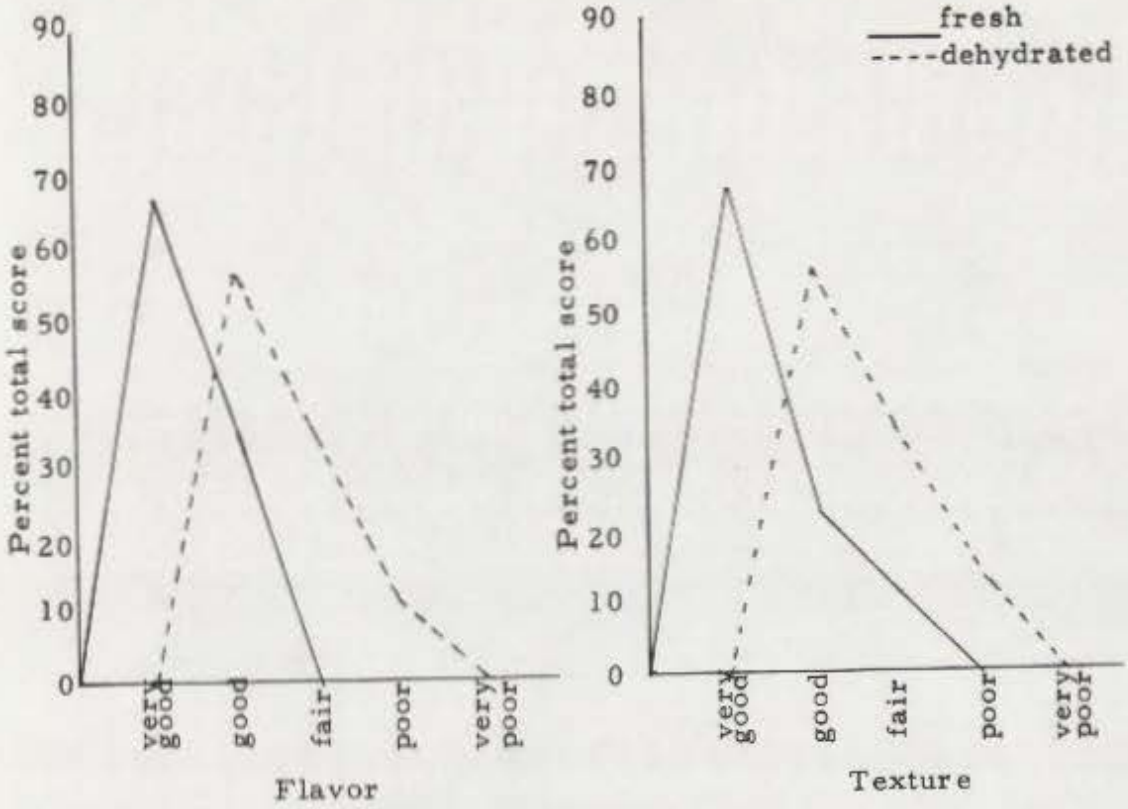


Figure 3. Graphs of weighted averages of taste panel scores for fresh and dehydrated chopped celery in chow mein.



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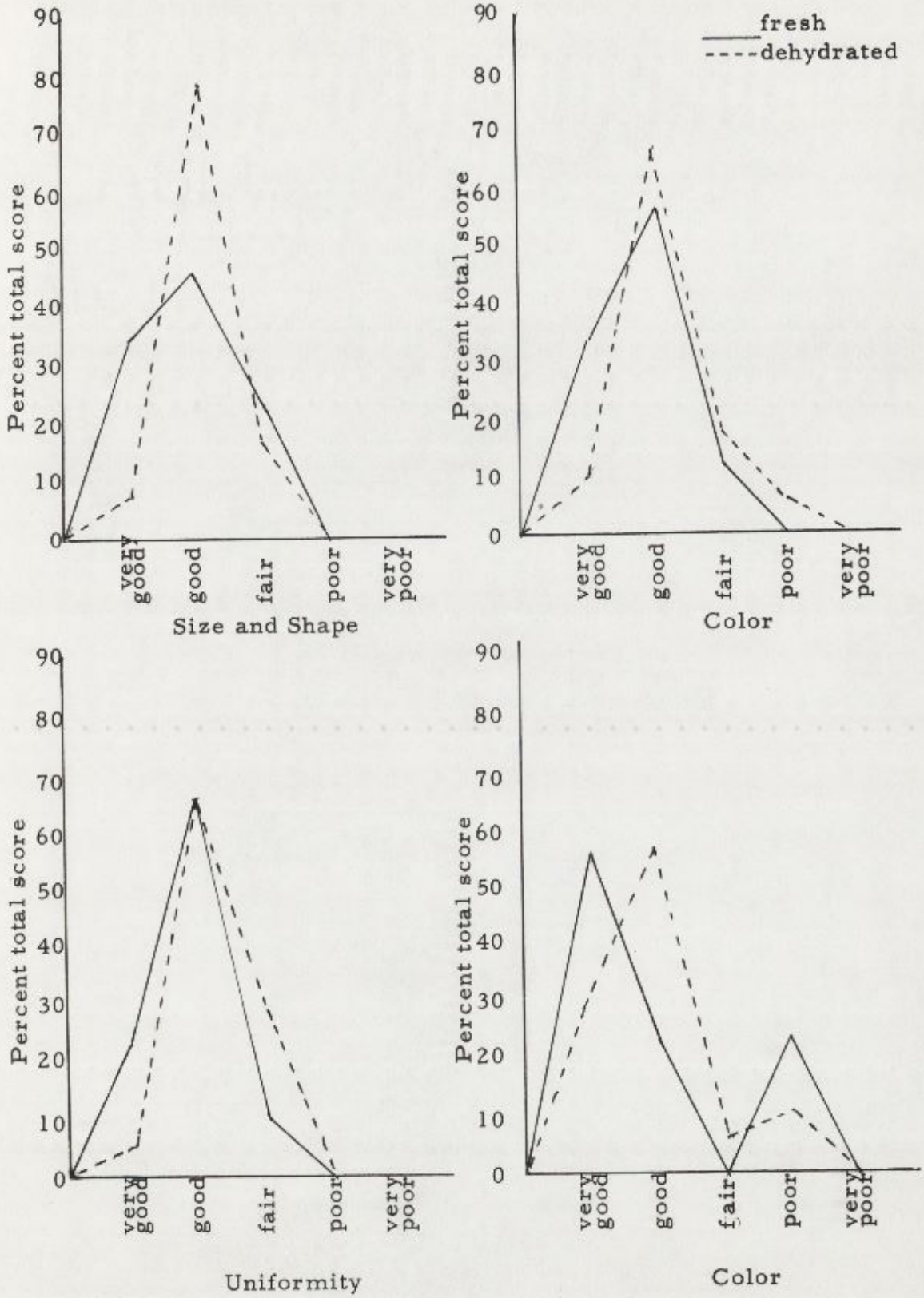
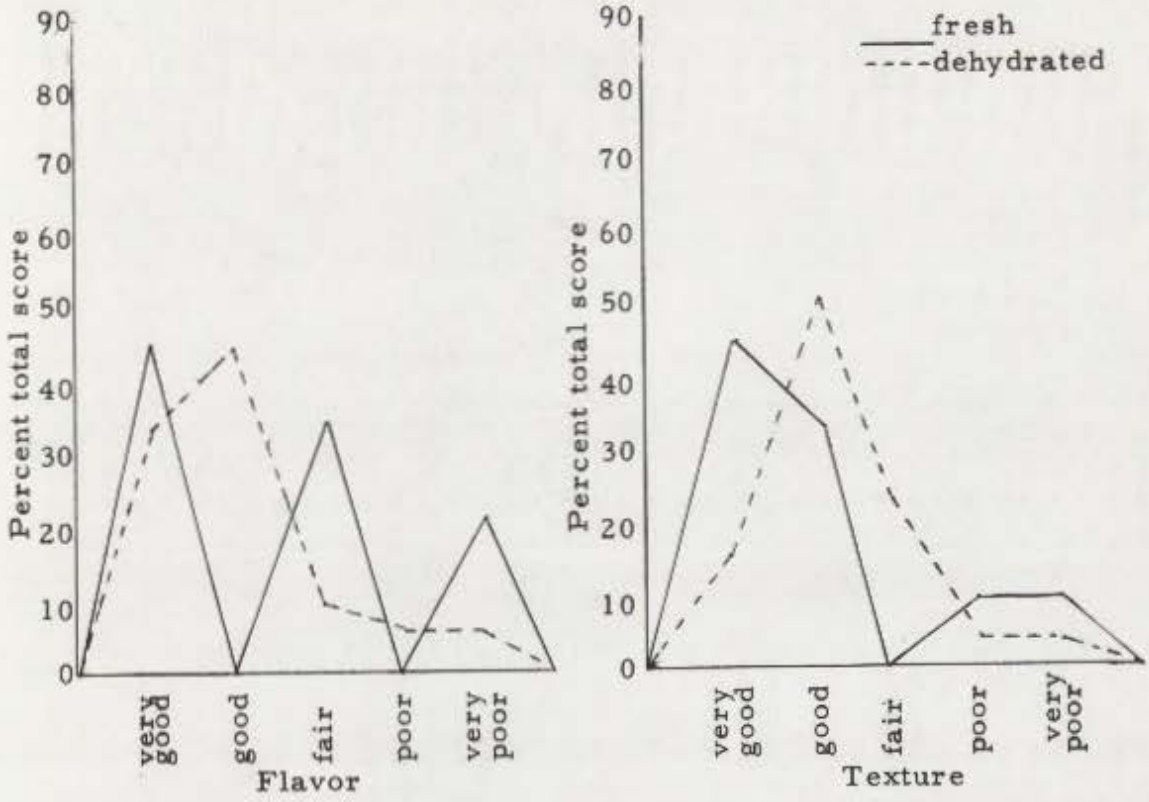


Figure 4. Graphs of weighted averages of taste panel scores for fresh and dehydrated sautéed chopped onions.



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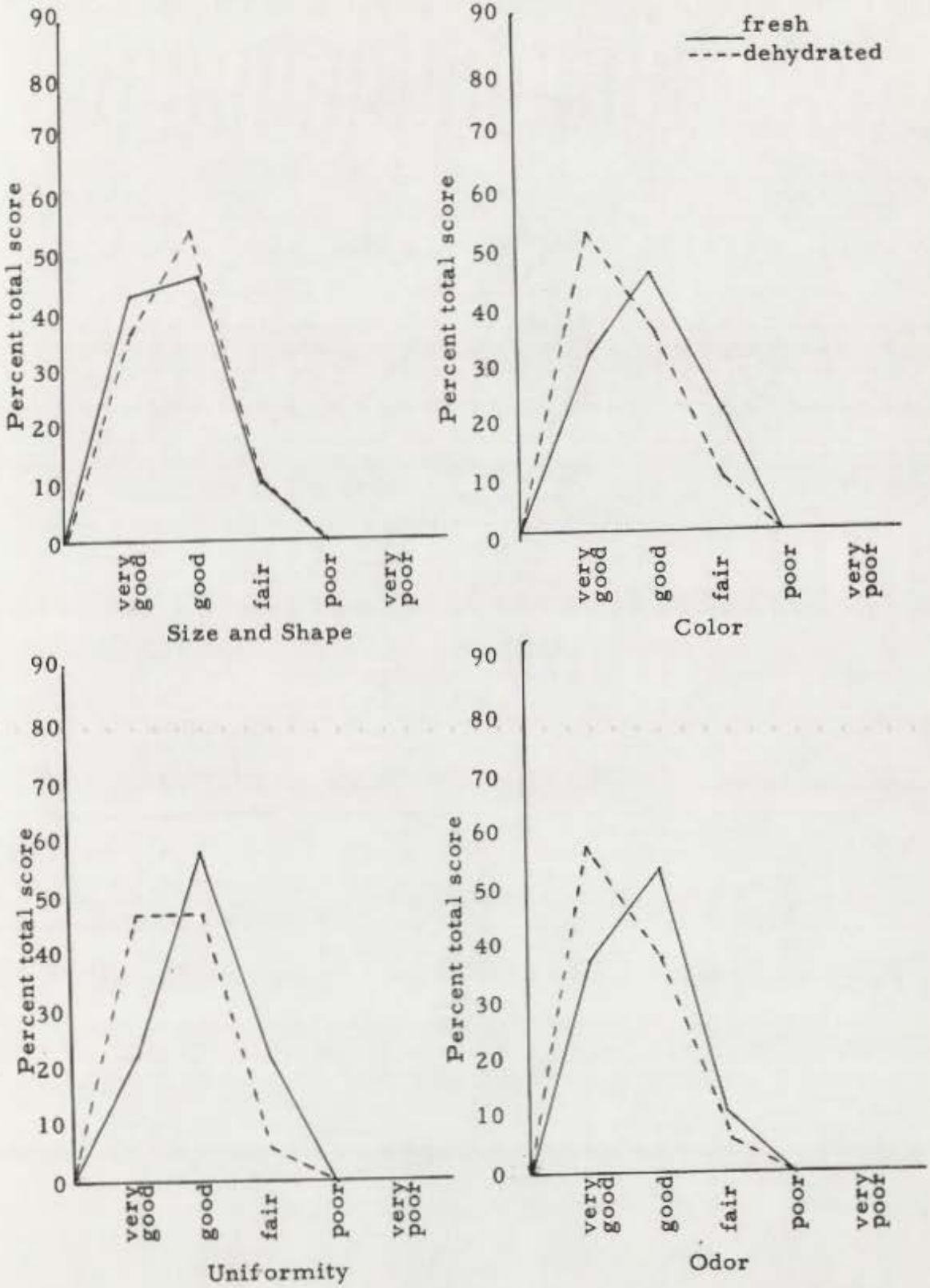
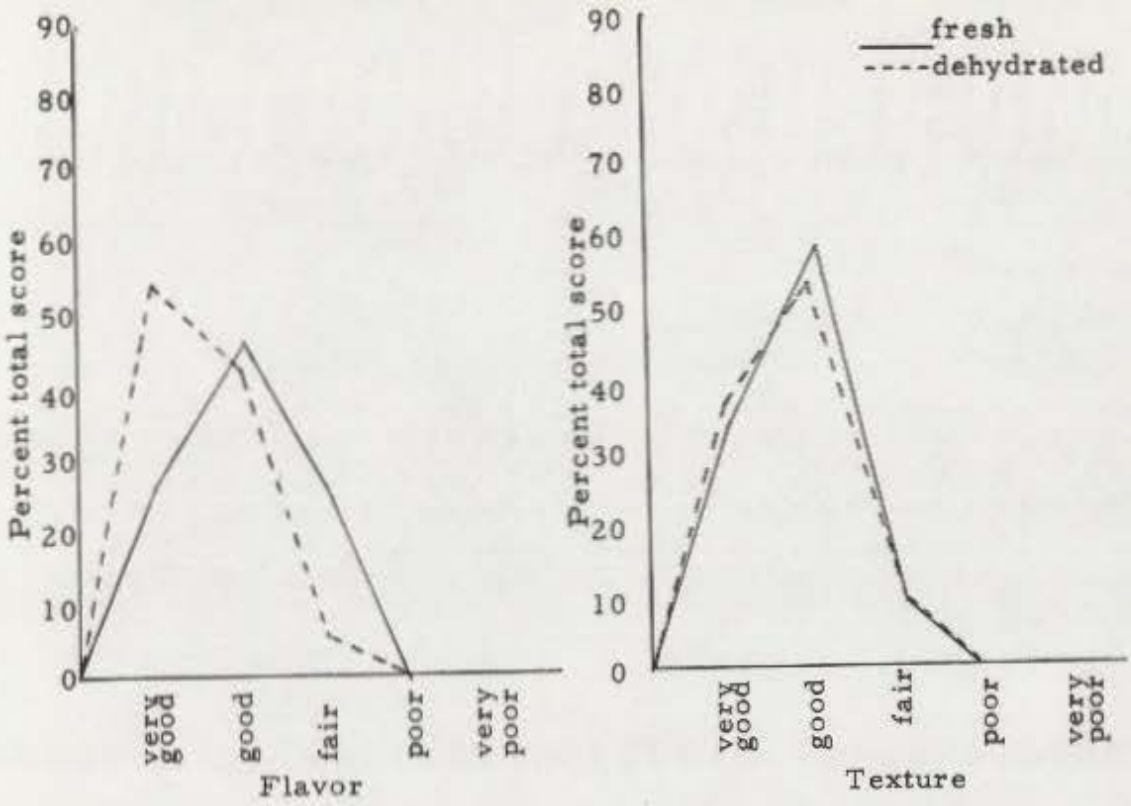


Figure 5. Graphs of weighted averages of taste panel scores for fresh and dehydrated chopped onions in shrimp creole.



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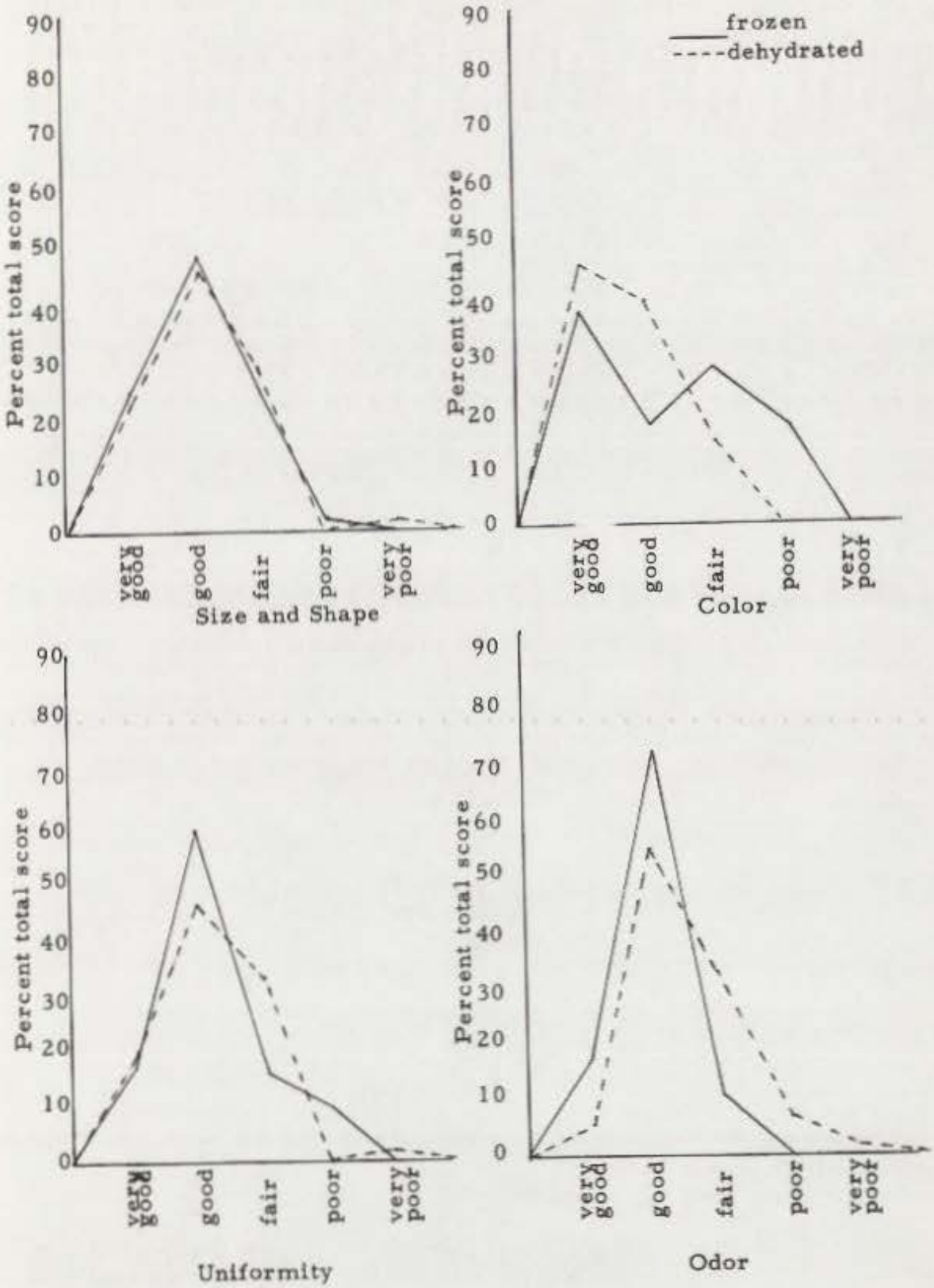


Figure 6. Graphs of weighted averages of taste panel scores for frozen and dehydrated peas.

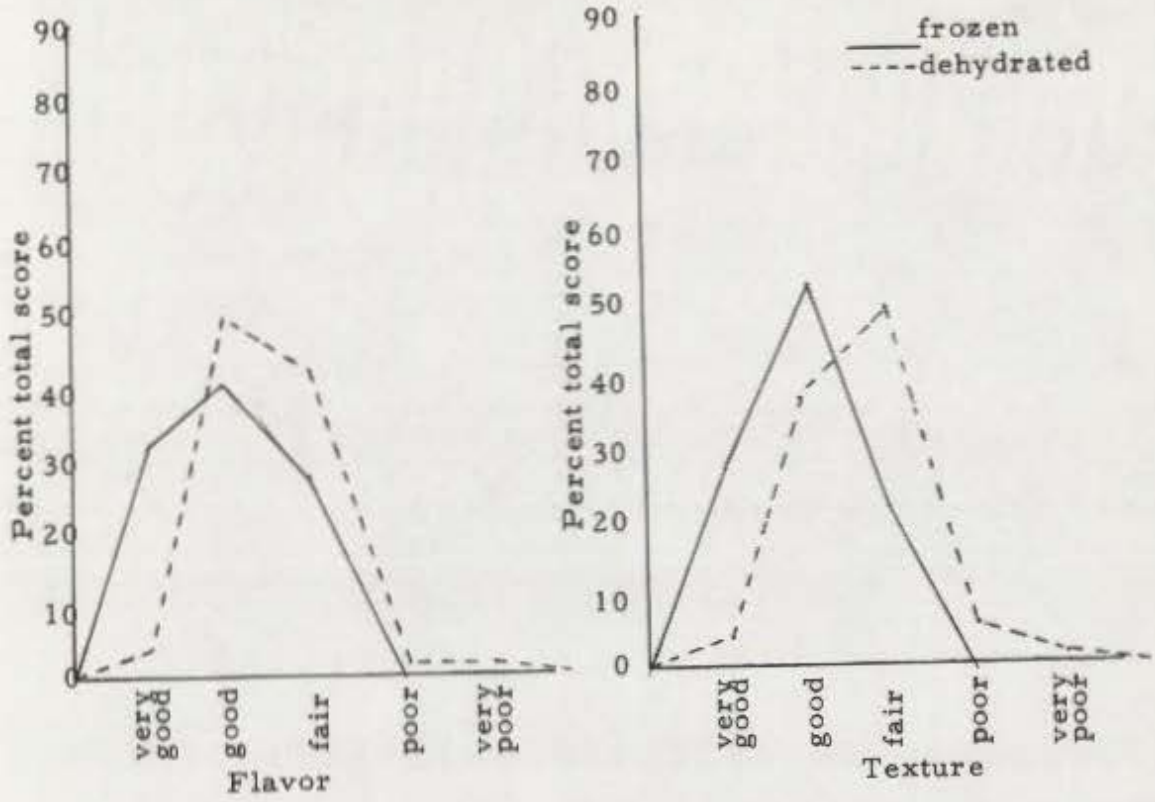


Figure 6. Continued.

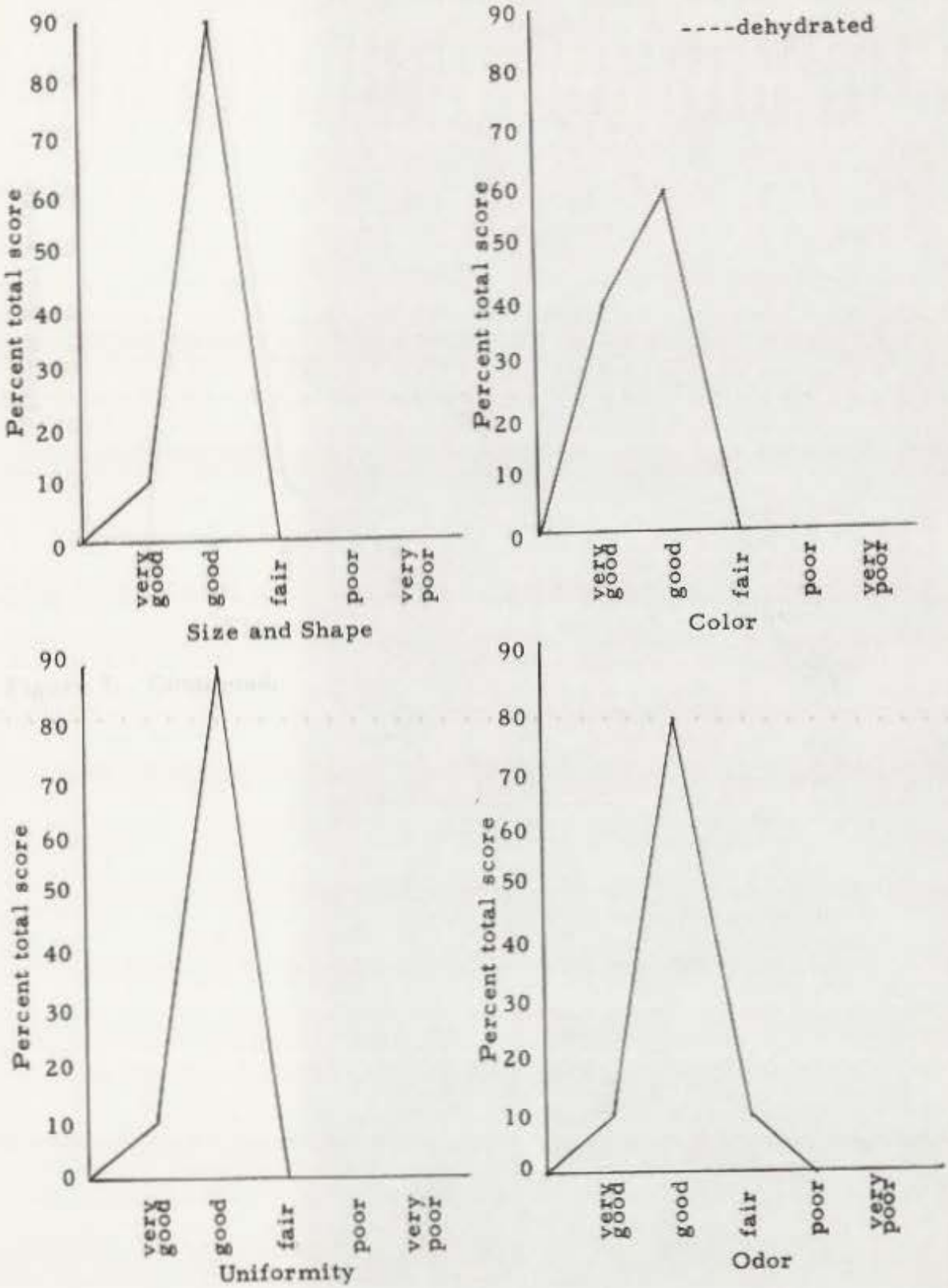
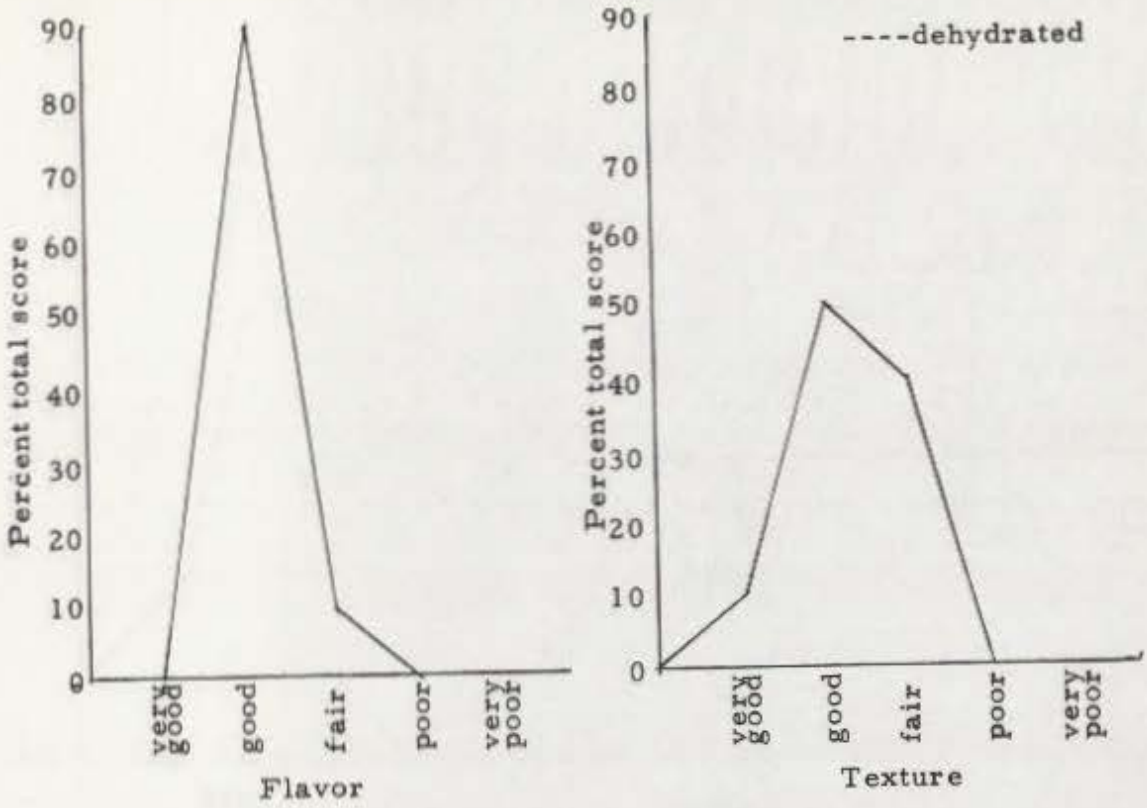


Figure 7. Graphs of weighted averages of taste panel scores for dehydrated peas and carrots in cream sauce.



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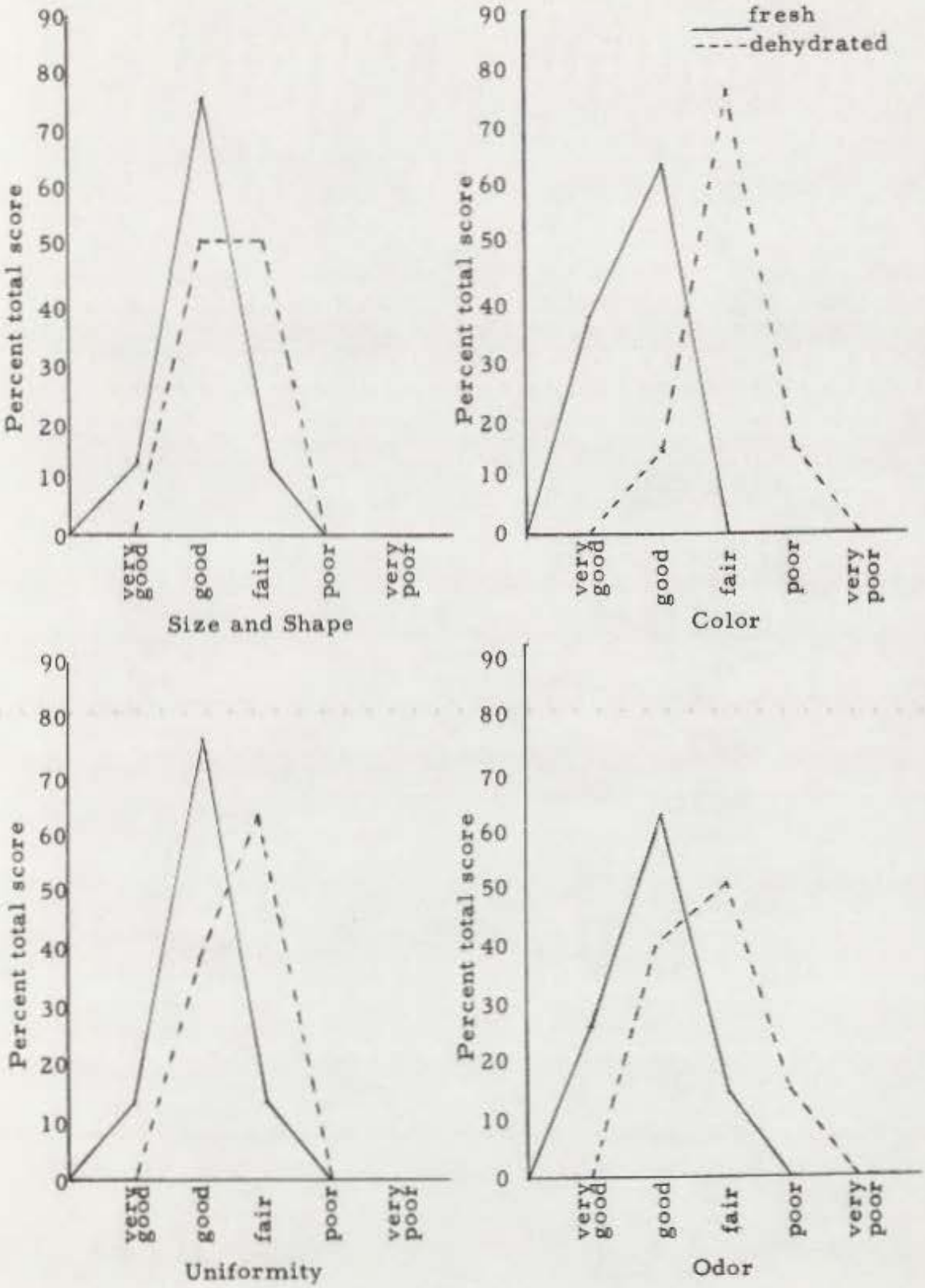
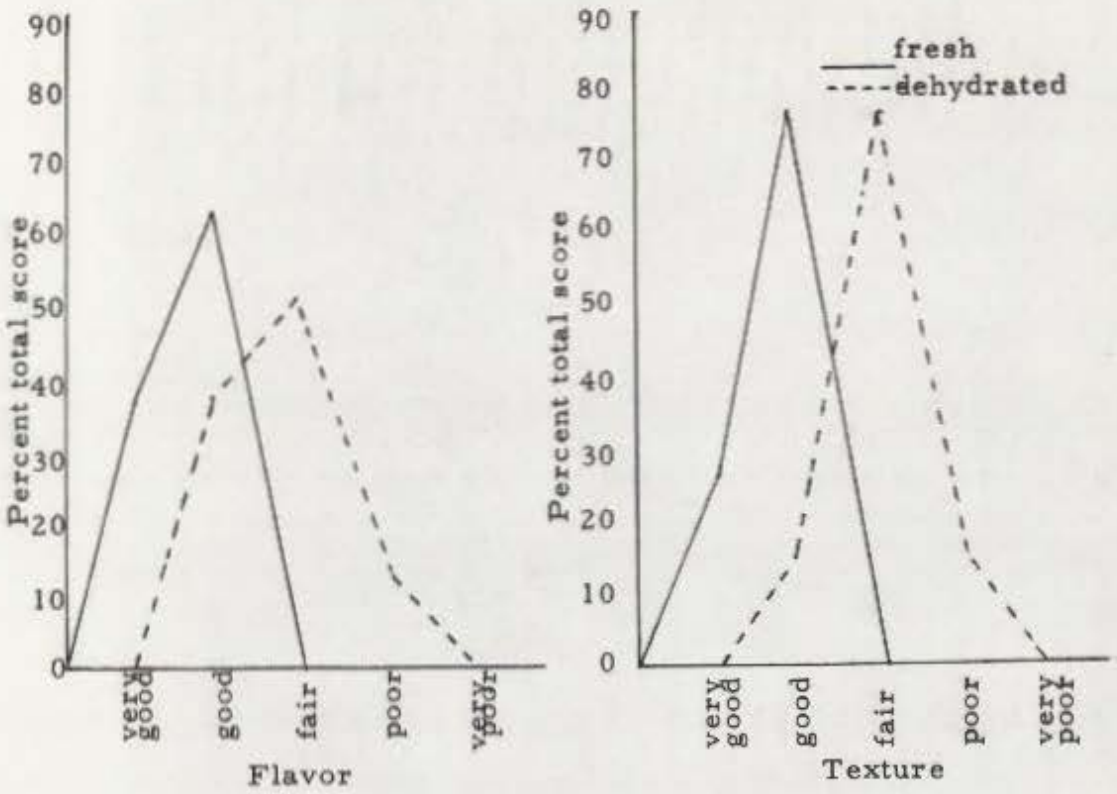


Figure 8. Graphs of weighted averages of taste panel scores for fresh and dehydrated sautéed green peppers.



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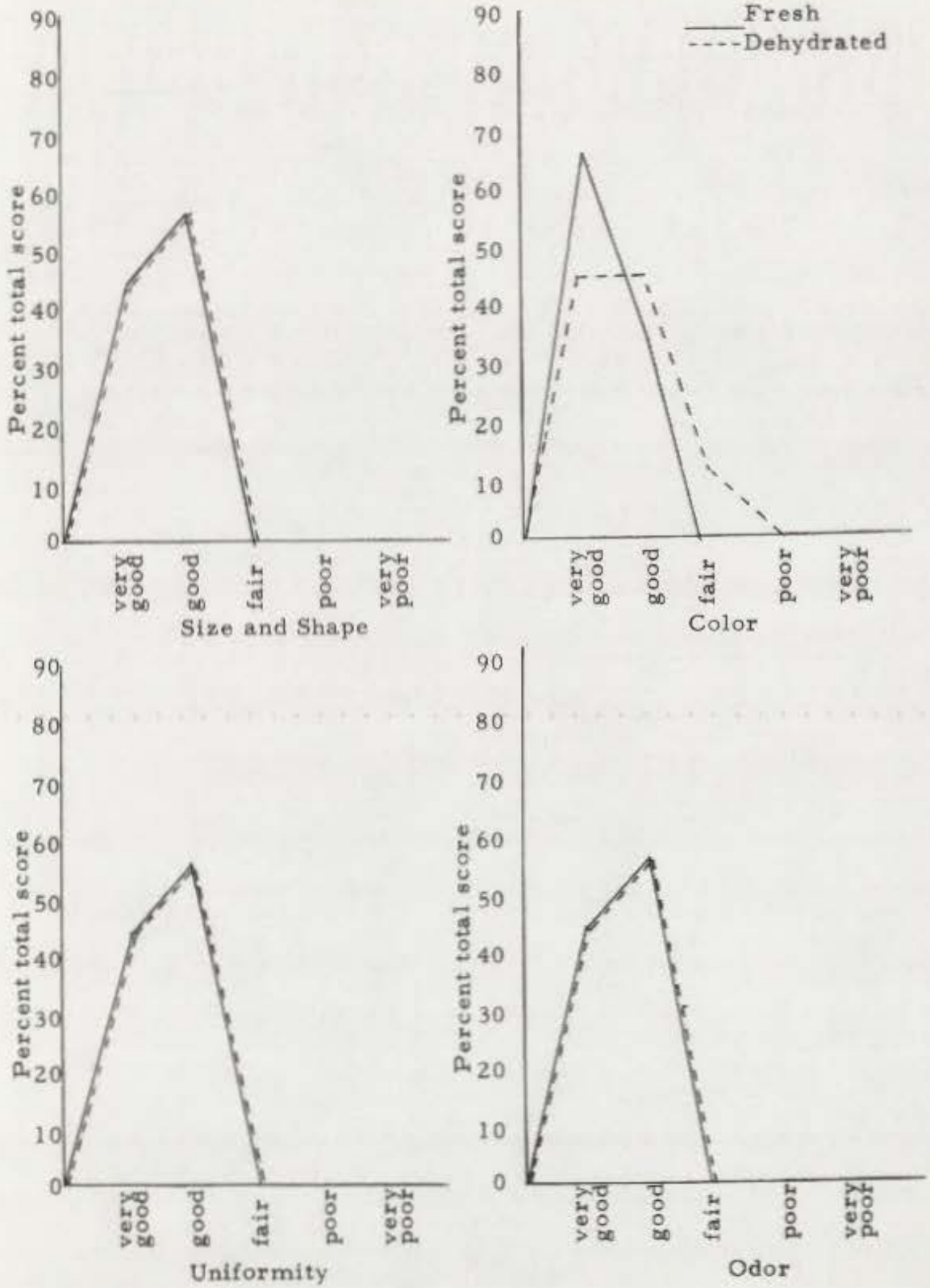
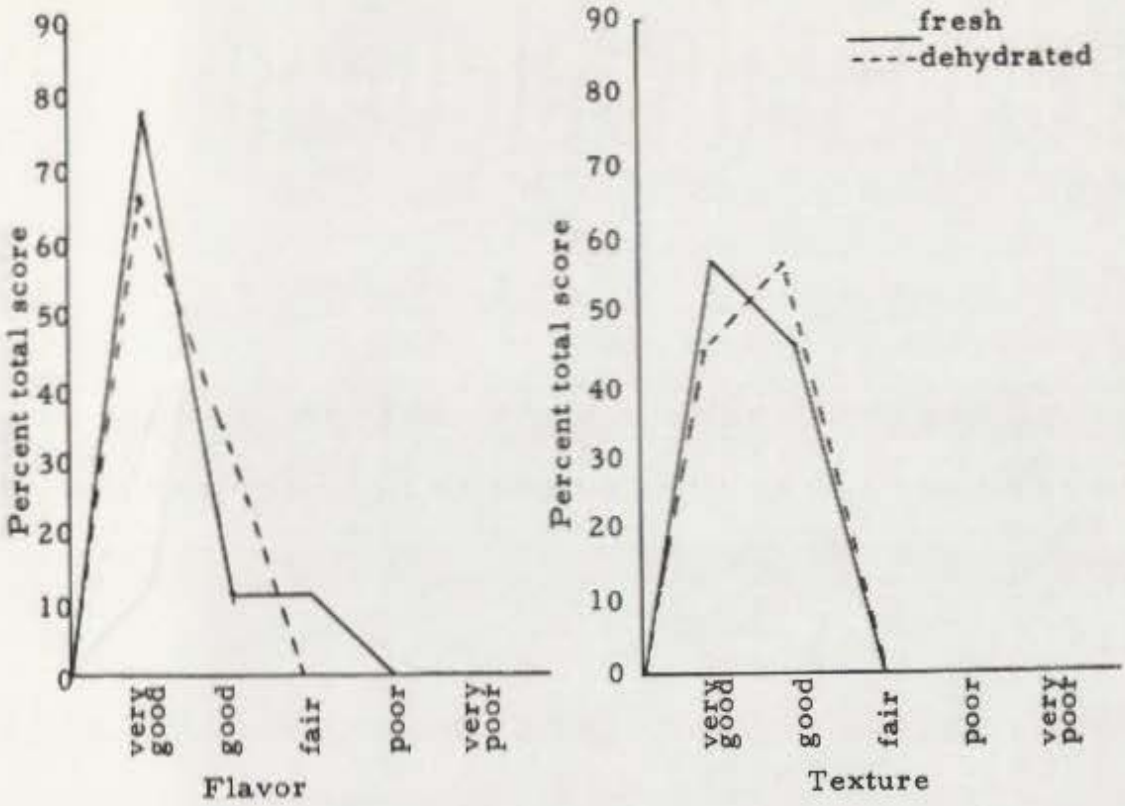


Figure 9. Graphs of weighted averages of taste panel scores for fresh and dehydrated green peppers in fried rice.



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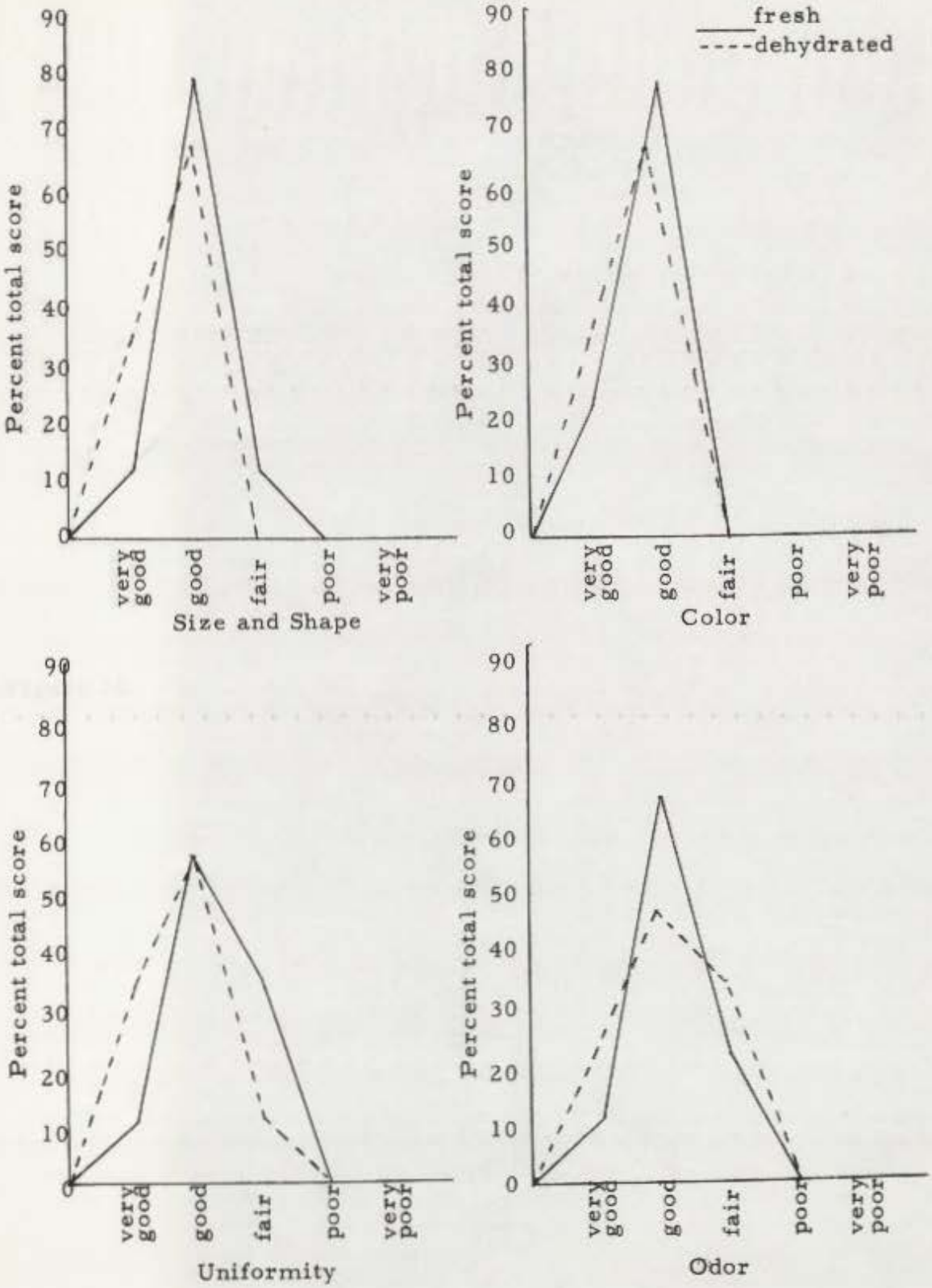
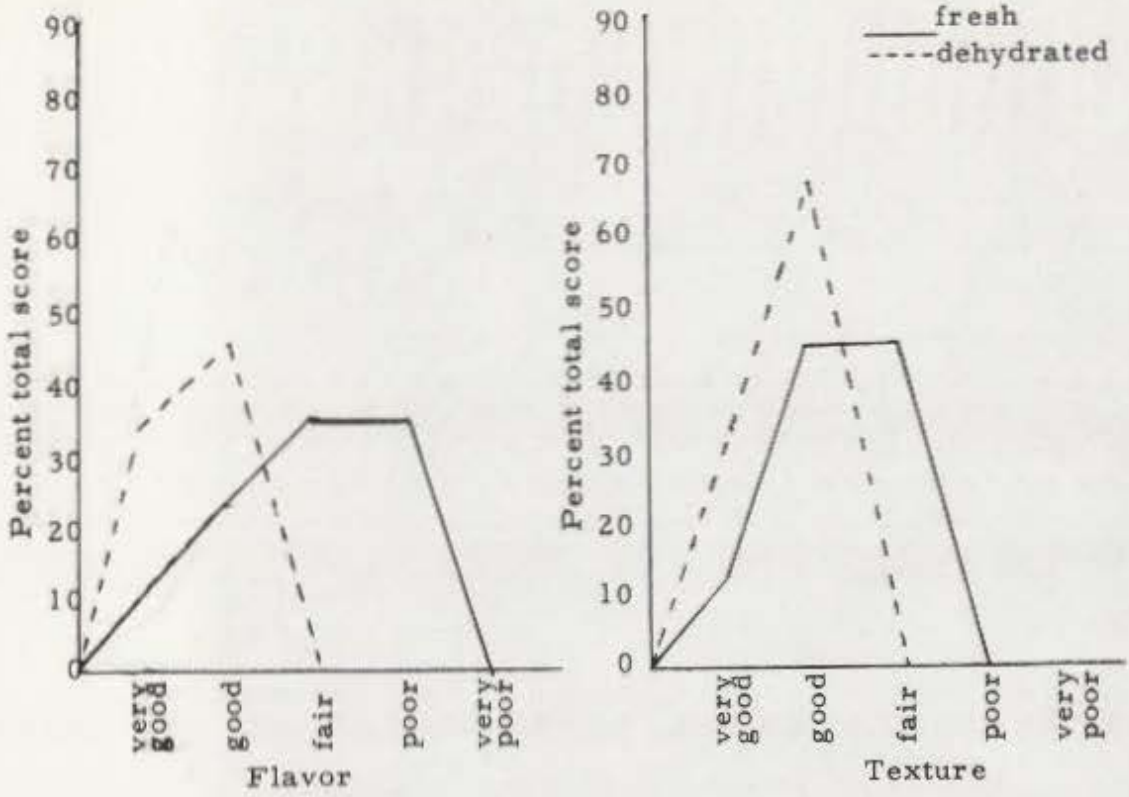


Figure 10. Graphs of weighted averages of taste panel scores for fresh and dehydrated diced potatoes.



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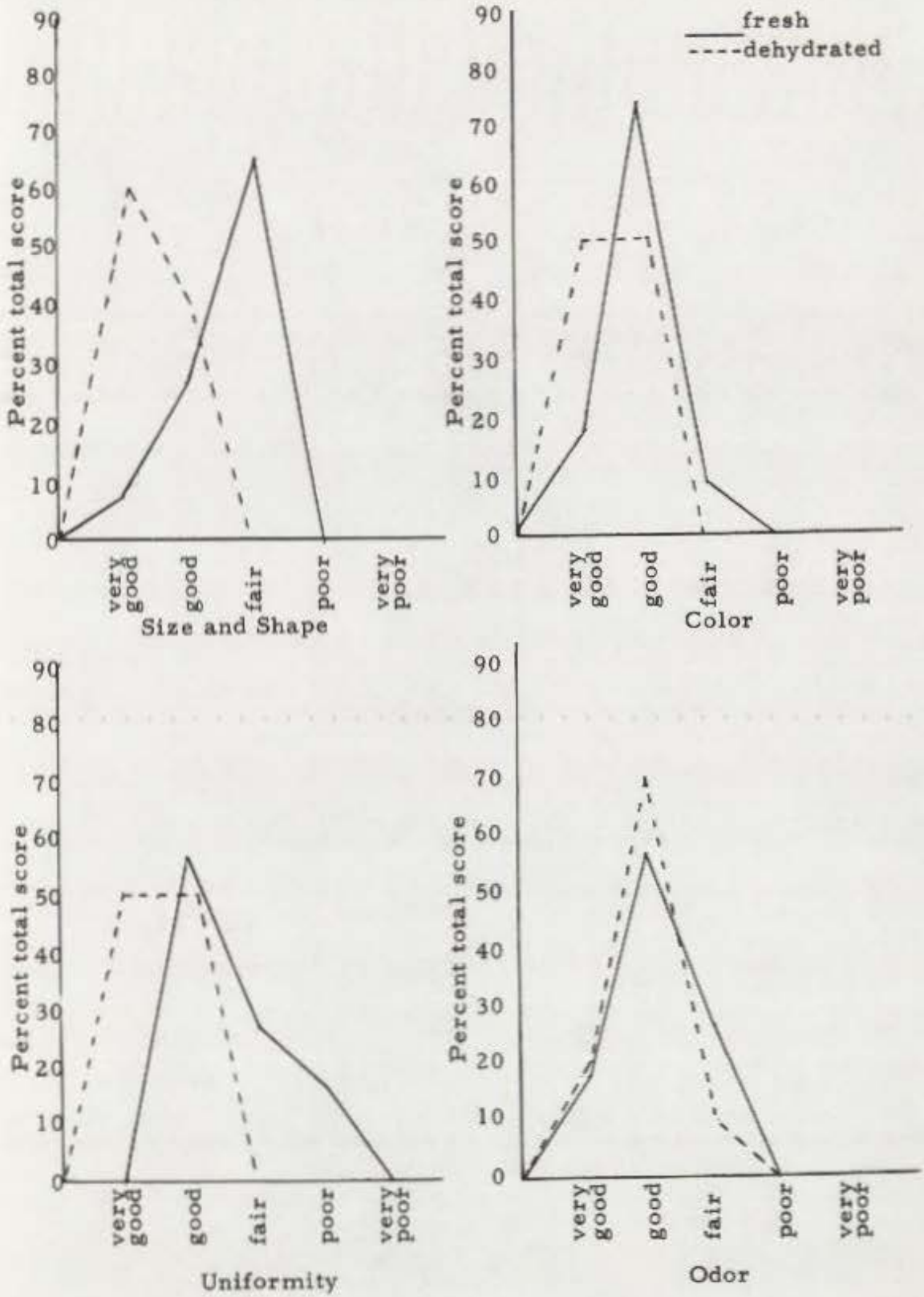
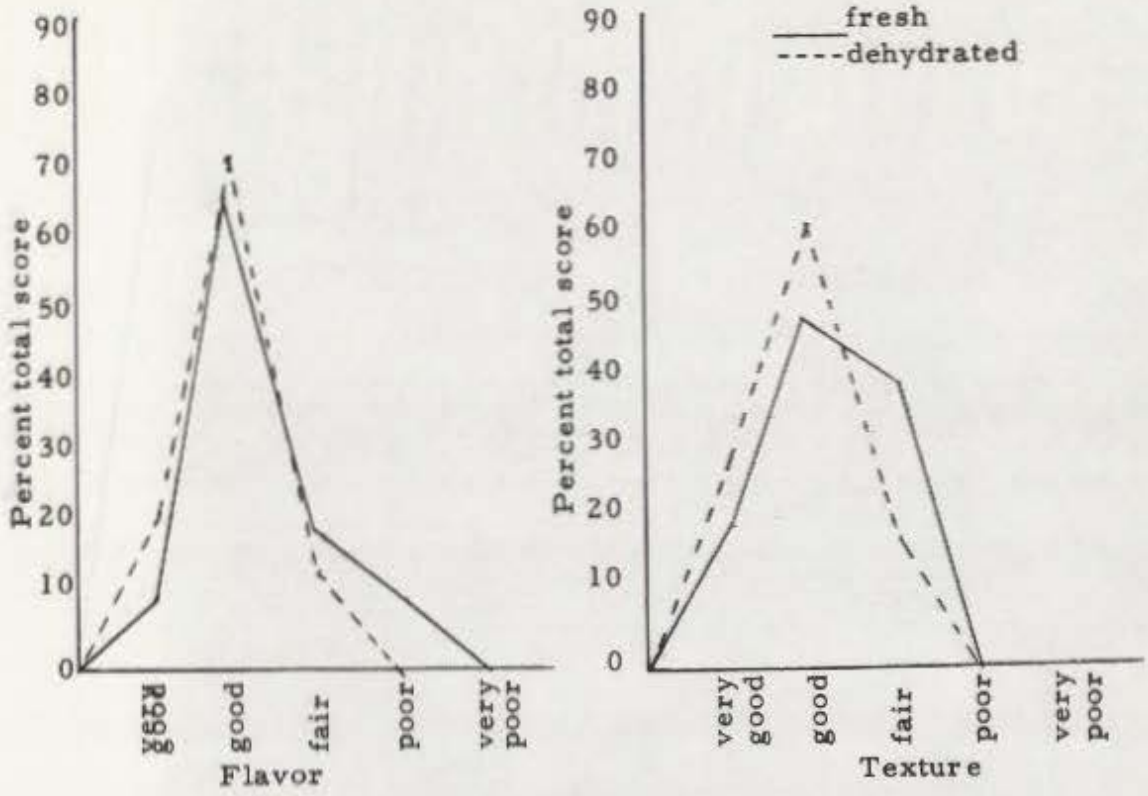


Figure 11. Graphs of weighted averages of taste panel scores for fresh and dehydrated shredded potatoes.



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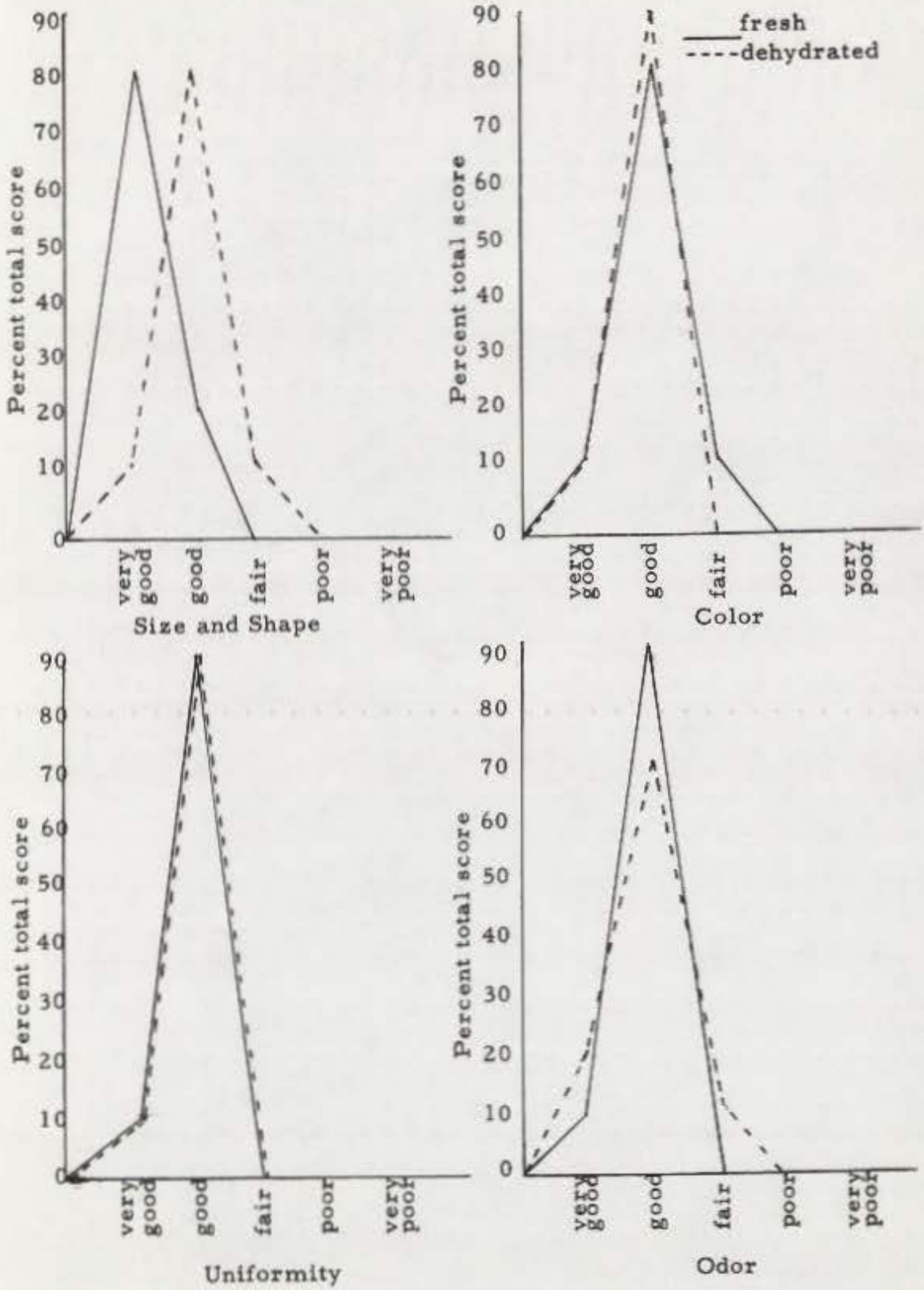
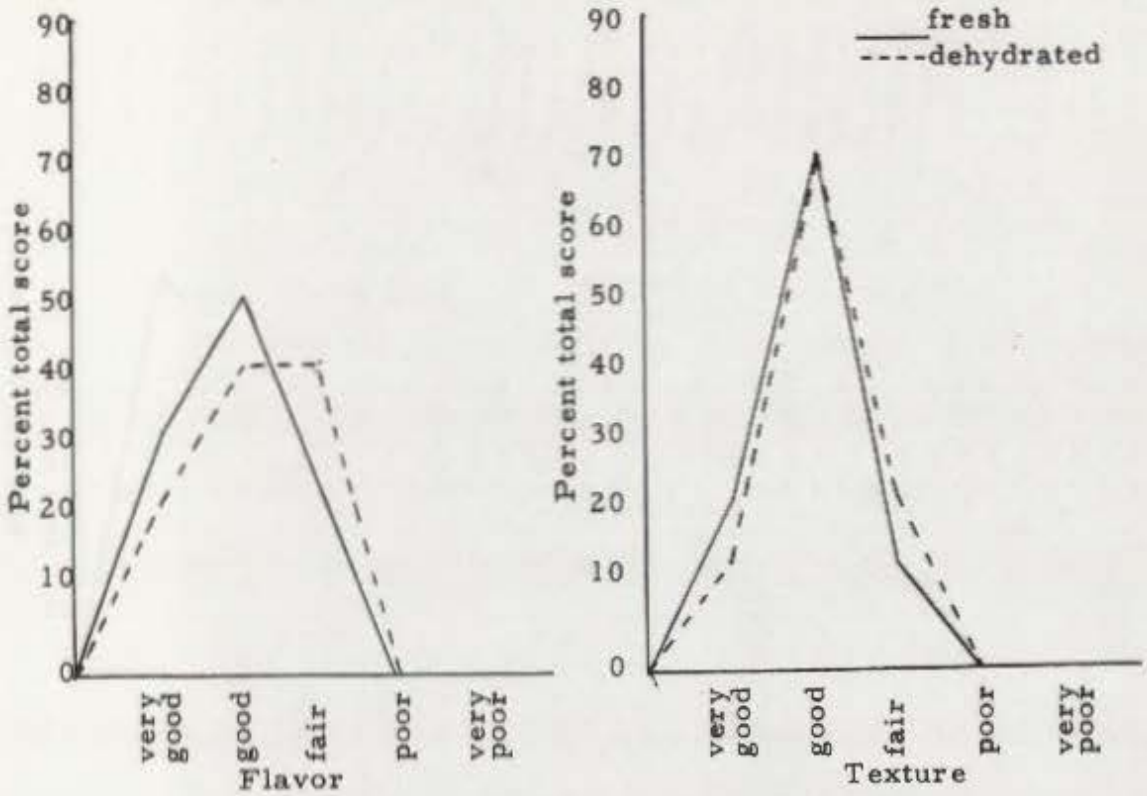


Figure 12. Graphs of weighted averages of taste panel scores for fresh and dehydrated sliced potatoes.



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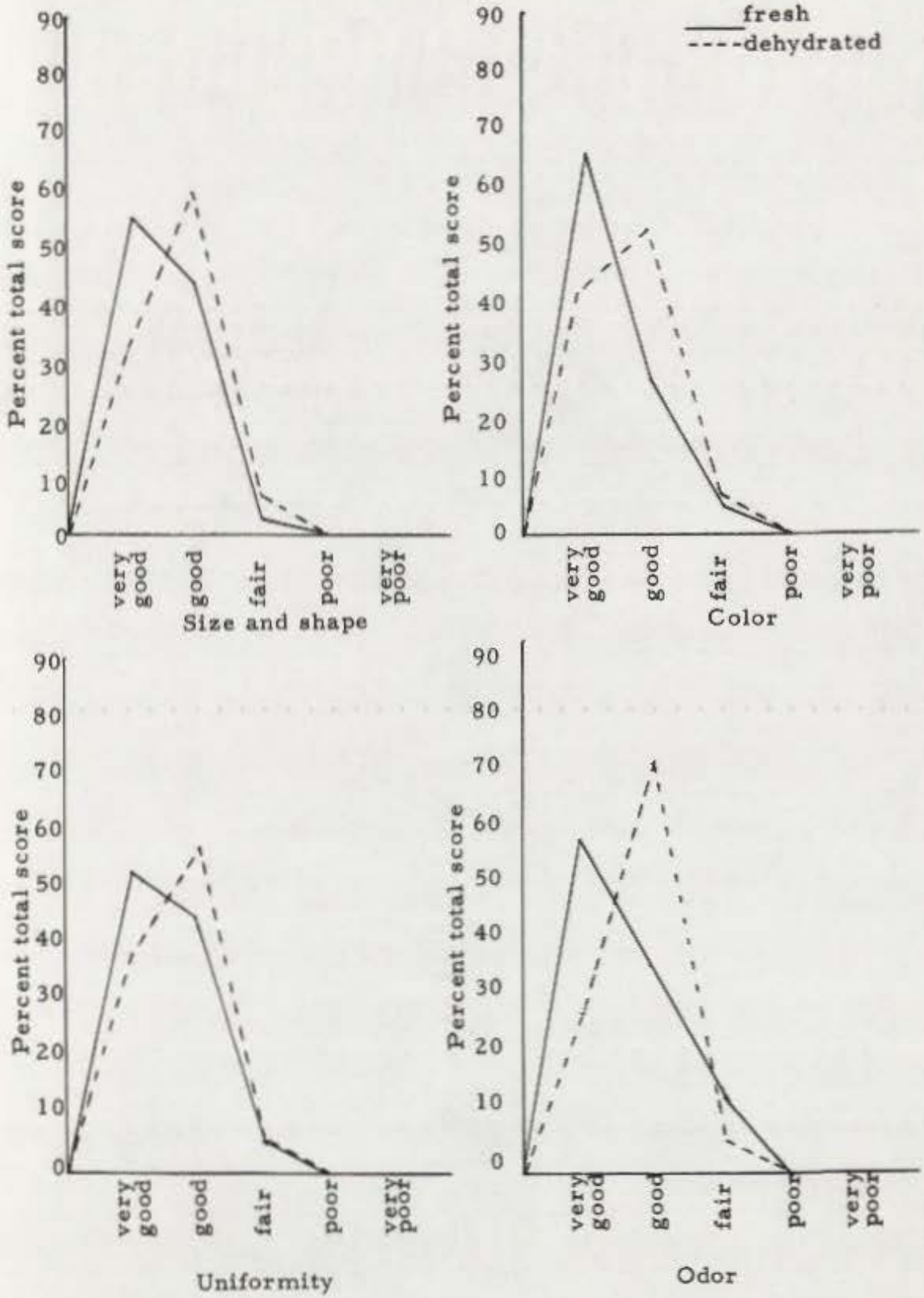

Figure 13. Graphs of weighted averages of taste panel scores for fresh and dehydrated whipped potatoes.

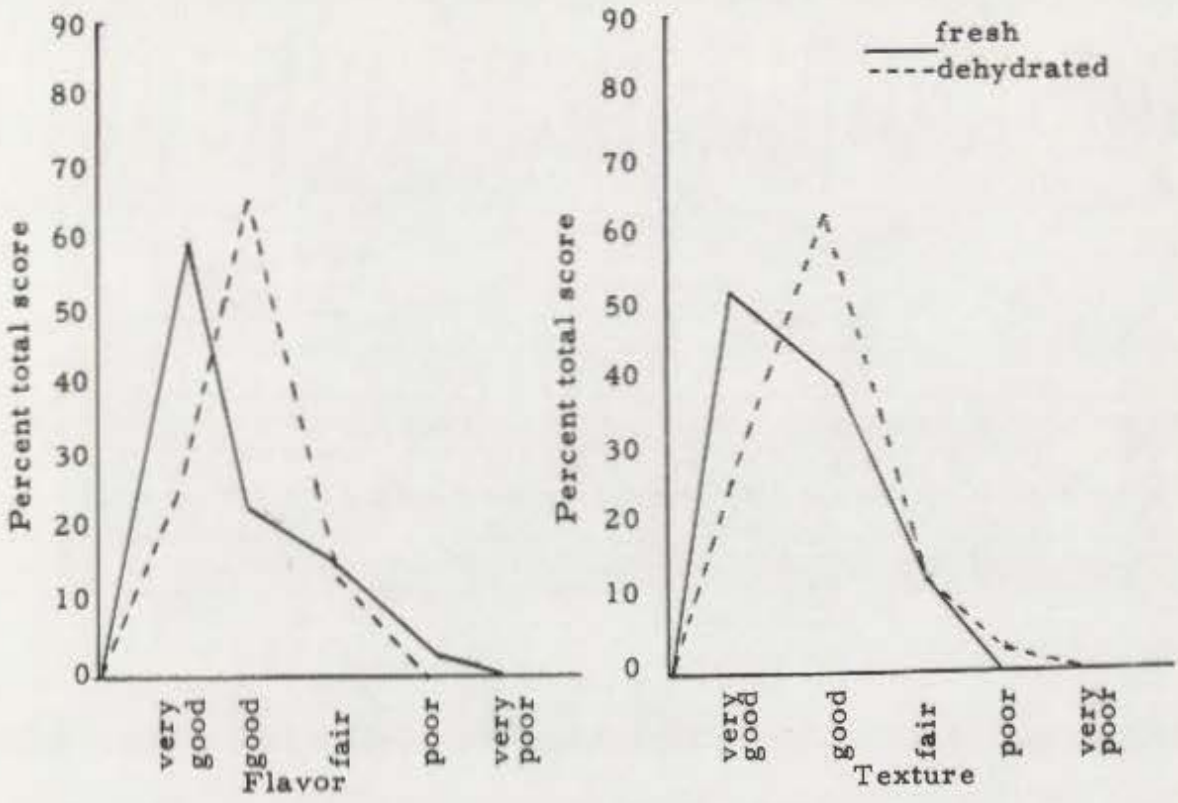

Figure 13. Continued.

VITA

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Candidate for the Degree of

Master of Science

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Major Field: Food and Nutrition

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