TECHNICAL REPORT
71-35-FL

EFFECT OF FREEZE-DRYING CONDITIONS ON THE QUALITY OF SPAGHETTI WIITH MEAT SAUCE

by
J. M. Tuomy, H. W. Shafer
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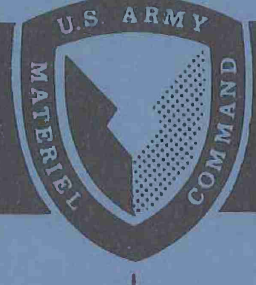
UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760



Food Laboratory
FL-126

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Foreword

Freeze-dried foods are being used in operational rations in increasing amounts. As main components in the Food Packet, Long Range Patrol (LRP), they have received excellent acceptance by troops in the field. However, more knowledge is needed on processing conditions in order to specify the best quality obtainable under commercial conditions.

There has been some evidence that drying conditions within presently accepted limits have enough effect on product quality and deterioration during storage to warrant tightening of specification requirements. Spaghetti with meat sauce is known to be the most susceptible to deterioration of the eight main components in the LRP. Therefore, this study was initiated to gain more information on the effects of drying conditions on this product.

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Abstract

The effects of freeze drying pressure, platen temperature, storage temperature, and storage time on appearance of product out of the dryer, rehydration ratio, and oxygen uptake of freeze-dried spaghetti with meat sauce were studied.

It was found that high dryer pressure (1.5 - 2.5 mm of mercury) appeared to cause vacuum drying and that high platen temperatures (175 - 200°F.) caused browning. Low pressure (0.5 mm of mercury) resulted in the best rehydration ratio, whereas low and high plate temperatures gave the best rehydration. While platen temperature and dryer pressure had statistically significant effects on oxygen uptake, their contribution to the total variance observed was small.

Introduction

Freeze-dried spaghetti with meat sauce is one of the components of the Food Packet, Long Range Patrol (LRP) and it is expected that it will be used in other operational rations. The oxygen uptake of this product has been shown to be considerably greater than it is with the other seven main components of the LRP under the same conditions (Tuomy et al, 1970). Since oxygen uptake is highly correlated with flavor deterioration (Tuomy et al, 1969a), spaghetti with meat sauce is the most susceptible to deterioration of the eight LRP items.

Tuomy et al (1969b) indicated that pressure and platen temperature in the freeze dryer had a significant effect on the oxygen uptake and thus on the organoleptic quality. However, this particular study was limited in the freeze drying conditions and in the storage time and temperatures. If it is true that the freeze drying conditions affect oxygen uptake, it may be possible to tighten specification requirements so as to increase a product's resistance to oxygen. This would minimize the effect of exposure of the product during packaging and the effects of partial or complete package failure.

This study was designed to determine the effect of freeze drying conditions on the oxygen uptake of freeze-dried spaghetti with meat sauce. Storage temperature and time were included in the study so that the magnitude of the drying effects could be compared with their known large effects (Tuomy et al, 1970).

Experimental Methods

The spaghetti with meat sauce was made in accordance with Interim Purchase Description IP/DES S-26-6, Food Packet, Long Range Patrol, dated 20 April 1966. The study was designed as a full factorial with the factors being freeze drying pressure (0.5, 1.0, 1.5, 2.0, 2.5 mm of mercury), platen temperature (100, 125, 150, 175, 200° F.), storage temperature (40, 70, 100° F.), and storage time (0,2, 4, 6, 8, 12, 16 weeks).

The cooked product was spread on trays measuring 39 x 22 x 1 inches. The filled trays were frozen in a -30° F. blast freezer, wrapped in freezer-paper and subsequently stored in a -30° F. holding freezer until freeze-dried. The storage time before freeze drying did not exceed 2 weeks.

Five trays of product were freeze-dried at the dryer platen temperatures of 100, 125, 150, 175, and 200° F., respectively, for each drying pressure of 0.5, 1.0, 1.5, 2.0 and 2.5 mm. Dehydration was to less than 2 percent moisture with radiant heat and the vacuum on the chamber was broken with nitrogen. Deviations from the appearance of spaghetti with meat sauce freeze-dried under normal conditions were noted. The dry product was packaged in No. 2½ cans, 125 grams per can, and sealed under atmospheric pressure. The canned product was stored at 40, 70 and 100° F. and three cans from each temperature were withdrawn at 2, 4, 6, 8, 12 and 16 weeks for evaluation.

The product was examined at the completion of drying and a judgement made as to its physical condition. In particular, estimates were made of the extent of any browning and the possibility of vacuum drying during processing as shown

by a glassy appearance of the product.

Headspace gas analyses were performed by chromatographic means in accordance with the procedure outlined by Bishov and Henick (1966). Prior to analysis the cans were allowed to equilibrate overnight to room temperature.

Total headspace volume in the can was determined by compressing 125 grams of product which was stored at 70° F. in a laboratory press at 5000 lbs. per square inch for 10 seconds and subtracting the volume of the resulting bar from the total volume of the can.

Rehydration value was obtained by rehydrating 125 grams of product with water at 180° F. for 5 minutes, draining the product for 1 minute on a wire screen with 1/8 inch square openings and reweighing. The product used was the 2 week withdrawal for each storage temperature. Rehydration ratio was calculated as weight of rehydrated product divided by weight of dry product.

Results and Discussion

Examination of the product out of the freeze-dryer indicated that at certain factor levels it either or both showed browning and had undergone vacuum drying during the process (Table 1). Browning is noted with all pressures when the temperature reached 175° F. Current specifications for practically all freeze-dried meat products limit product temperature to 150° F. or lower and the results of this study would indicate that this requirement should be maintained for spaghetti with meat sauce. Table 1 also shows that there was evidence of at least partial vacuum drying (glassy appearance) starting at a pressure of 1.5 mm and becoming worse as the pressure was increased. Platen temperature did not

promote vacuum drying. Present specifications for freeze-dried meat products limit pressure to a maximum of 1.5 mm. The results of this study would indicate that the maximum should be set at 1.0 mm for spaghetti with meat sauce.

Rehydration ratios for the product stored for two weeks are shown in Table 2. Analysis of variance results for rehydration along with the percent of observed variance attributable to the factors are shown in Table 3. The storage temperature was not significant since the products were tested after only 2 weeks of storage. It would be expected that storage temperature would have a significant effect on rehydration after longer periods of time, but for this study the main interest was in the effects of pressure and platen temperature. Both pressure, platen temperature and their interaction had effects significant at the 1% level with pressure and the interaction contributing the largest share to the variance. Analysis of the pressure means by the Duncan Multiple range test showed that a pressure of 0.5 mm gave significantly better (5% level) rehydration than the other four pressures. With the platen temperatures, the highest and lowest gave better rehydration than the middle temperatures. The interaction is in the same direction as the main effects.

Table 4 shows the oxygen uptake results for the study in ml per 125 grams of product. Table 5 gives the analysis of variance results along with the percent of observed variance attributable to the factors. All of the factors and interactions were significant at the 1% level, but pressure, platen

temperature and their interactions actually contributed only a small amount to the total variance observed. In view of the observation that with some platen temperatures browning occurred and at some pressures vacuum drying occurred, the results for oxygen uptake at what would be considered satisfactory conditions were isolated. The results were almost identical with the values shown in Table 5 with the exception that platen temperature and the platen temperature X storage time interaction were not significant.

Conclusions

It is evident that both platen temperature and dryer pressure affect the rehydration ratio of spaghetti with meat sauce. Low temperatures and pressures can be expected to give the best results although some compromise must be made with temperature in order to have reasonable drying times. While the pressure and temperature are shown in this study to have significant effects on oxygen uptake the amount they contributed to the total variance observed in the study was so small that it can be ignored for all practical purposes. Observations of the product out of the dryer indicate that pressure and platen temperature (dry product temperature) should be reevaluated for specification purposes.

Table 1. Observations of product condition when removed from freeze dryer.

Freeze-Drying Conditions		Product Color			Type of Drying*		
Pressure (mm)	Platen Temp of	Normal	Browned	Burnt	Normal	Partial Vac. Dry	Extensive Vac. Dry
0.5	100	X			X		
	125	X			X		
	150	X			X		
	175		X		X		
	200			X	X		
1.0	100	X			X		
	125	X			X		
	150	X			X		
	175		X		X		
	200			X	X		
1.5	100	X				X	
	125	X				X	
	150	X				X	
	175		X			X	
	200			X		X	
2.0	100	X					X
	125	X					X
	150	X					X
	175		X				X
	200			X			X
2.5	100	X					X
	125	X					X
	150	X					X
	175		X				X
	200			X			X

* Vacuum drying indicated by glassy appearance of the product.

Table 2. Rehydration ratios of product after two weeks storage.

Freeze-Drying Conditions		Storage Temperature		
Pressure (mm)	Platen Temp of	40° F.	70° F.	100° F.
0.5	100	2.957	2.965	2.966
	125	2.584	2.502	2.634
	150	2.519	2.537	2.608
	175	3.061	3.025	2.931
	200	2.720	2.750	2.738
1.0	100	2.298	2.189	2.108
	125	2.316	2.355	2.345
	150	2.299	2.197	2.437
	175	2.463	2.451	2.305
	200	2.696	2.538	2.835
1.5	100	2.554	2.521	2.569
	125	2.338	2.267	2.347
	150	2.424	2.340	2.468
	175	2.534	2.663	2.516
	200	2.471	2.484	2.594
2.0	100	2.364	2.463	2.550
	125	2.564	2.568	2.649
	150	2.427	2.347	2.331
	175	2.516	2.471	2.489
	200	2.928	2.941	2.921
2.5	100	2.406	2.424	2.443
	125	2.289	2.234	2.272
	150	2.401	2.410	2.386
	175	2.445	2.452	2.431
	200	2.279	2.239	2.231

Table 3. Analysis of variance results for rehydration ratios.

Factor	Significance*	% of variance
Pressure (A)	XX	42.9
Platen Temp (B)	XX	14.5
Storage Temp (C)	n.s.	-
AB	XX	37.6
AC	n.s.	-
BC	n.s.	-
Remainder	-	5.0
		100.0

* XX Significant at the 1 percent level

n.s. Not significant at the 5 percent level

Table 4. Average oxygen uptake of spaghetti with meat sauce sealed at atmospheric pressure with 125 grams of product in a No. 2½ can.

Platen temp	Storage temp	Dehydrator Pressure (ml of mercury) 0.5 — Time (weeks)						1.0						1.5						2.0						2.5					
°F.	°F.	2	4	6	8	12	16	2	4	6	8	12	16	2	4	6	8	12	16	2	4	6	8	12	16	2	4	6	8	12	16
	40	7.5	8.9	14.2	14.2	18.6	28.3	2.9	6.0	9.7	20.9	27.9	31.6	3.7	6.7	19.5	31.5	33.7	42.0	11.3	13.6	23.4	25.0	37.8	50.7	15.9	22.7	30.3	47.0	56.8	61.4
		6.7	8.2	14.9	14.9	17.9	22.4	2.9	5.2	9.7	18.7	22.6	30.1	3.7	8.2	18.7	28.5	35.2	45.7	10.6	14.4	19.7	28.0	45.4	45.4	15.2	20.5	27.3	47.7	52.3	63.7
		7.1	8.5	14.6	14.6	18.3	25.4	2.2	6.0	10.5	20.2	25.6	36.2	3.7	9.7	18.7	30.0	40.5	46.5	12.1	10.6	18.9	28.0	47.6	49.9	16.7	20.5	28.0	50.8	54.6	62.6
100	70	15.7	18.6	27.6	36.5	59.6	81.2	6.7	14.2	23.2	34.4	61.8	82.9	10.5	27.7	47.2	64.4	86.9	117.7	18.1	31.8	44.6	62.0	95.3	127.0	27.3	46.2	59.9	81.1	114.4	143.2
		14.9	17.9	27.6	36.5	62.6	84.2	7.5	15.0	24.7	36.7	58.0	85.1	15.0	32.2	45.7	65.9	88.4	114.7	18.9	29.5	46.1	62.8	94.5	124.0	25.0	44.0	56.8	81.9	116.0	133.4
		13.4	17.9	32.0	38.0	59.6	96.1	6.7	15.0	26.2	35.1	59.9	87.4	13.5	27.7	47.2	66.7	83 9	105.7	19.7	35.5	45.4	59.0	100.6	125.5	26.5	43.2	61.4	81.1	111.4	141.0
	100	21.6	29.1	46.2	63.4	120.7	146.8	12.7	20.9	32.9	52.4	95.5	147.7	18.0	33.0	51.0	67.4	120.7	144.6	25.7	39.3	70.3	81.7	131.6	149.0	34.1	47.0	79.6	94.0	135.7	150.1
		22.4	28.3	46.2	67.8	125.9	147.6	13.4	23.2	33.7	53.1	143.9	149.2	19.5	34.5	48.0	63.7	135.6	148.4	24.2	40.1	63.5	93.0	132.3	149.7	29.6	51.5	77.3	105.3	141.0	150.1
		21.6	28.3	43.2	67.1	140.9	147.6	12.7	23.9	36.7	55.4	119.1	149.2	18.0	35.2	47.2	63.7	120.7	148.4	25.7	37.8	67.3	88.5	138.4	149.7	35.6	51.5	78.5	101.6	130.4	150.1
125	40	3.7	7.5	9.7	17.9	26.2	28.4	2.9	9.7	18.0	25.4	39.6	41.0	6.0	6.0	18.9	24.1	43.8	43.8	4.5	10.5	30.0	30.7	39.7	48.7	4.5	10.6	17.4	22.7	31.8	48.5
		3.7	9.7	9.7	16.4	25.4	26.9	2.9	8.2	16.5	26.1	46.3	45.5	3.8	6.0	20.4	24.9	38.5	43.8	4.5	9.7	28.5	30.0	44.2	47.2	4.5	10.6	18.2	23.5	32.6	47.7
		3.7	9.0	10.5	16.4	25.8	27.6	2.9	9.0	18.0	21.6	40.3	43.3	3.8	4.5	19.6	27.2	39.2	43.0	3.7	9.7	28.5	30.7	40.5	49.5	3.6	11.4	18.2	37.9	31.1	43.9
	70	7.5	17.2	22.4	29.9	47.8	56.0	9.0	26.9	37.4	47.8	82.1	111.9	12.1	12.1	39.2	50.6	70.9	103.4	15.0	30.0	51.7	57.7	89.2	102.7	10.6	21.2	31.8	36.4	67.4	73.5
		7.5	17.9	20.2	29.1	44.9	58.3	10.5	28.4	35.1	50.0	78.4	109.7	10.6	12.1	35.5	51.3	75.5	110.2	10.5	29.2	48.0	57.7	81.7	108.7	12.1	23.5	34.1	40.2	50.8	86.4
		6.0	17.9	21.7	30.6	48.6	62.0	9.0	24.7	39.6	48.5	80.6	119.4	11.3	13.6	34.0	49.0	76.2	102.6	11.2	28.5	48.7	57.0	78.7	108.7	11.4	22.0	34.1	37.9	62.1	87.1
	100	12.7	21.7	30.6	42.6	67.3	100.9	17.2	35.1	52.2	69.4	139.6	147.8	17.4	32.4	43.8	49.8	89.0	108.6	18.7	34.5	50.2	62.2	92.2	134.9	20.5	34.1	49.2	61.4	85.6	118.9
		12.7	23.2	29.9	44.8	67.3	112.1	16.4	39.6	46.3	74.6	137.3	147.8	18.9	33.2	37.0	47.5	89.8	110.9	22.5	33.7	45.0	60.0	94.4	128.1	20.5	34.8	51.5	63.6	82.4	115.9
		12.0	22.4	32.1	48.6	67.3	103.9	20.2	34.4	51.5	81.3	134.3	147.8	19.6	30.2	39.2	55.8	100.3	124.5	21.7	33.7	48.0	56.2	93.7	141.6	18.9	34.4	53.0	62.5	89.0	117.4
	40	3.7	9.0	12.7	28.4	32.9	37.3	3.0	5.3	8.3	13.5	24.0	35.3	6.8	7.5	20.3	19.6	33.2	42.2	3.8	6.0	14.3	21.1	27.1	52.0	3.8	8.3	16.7	25.8	37.9	47.0
		3.7	9.0	12.7	26.1	31.4	37.3	3.0	4.5	7.5	12.0	23.3	27.8	6.0	7.5	19.6	21.1	30.1	42.9	3.0	6.0	15.8	18.8	32.4	49.8	2.3	8.3	16.7	25.0	38.6	43.9
		3.7	9.7	12.7	28.4	31.4	39.6	3.0	4.9	6.8	12.8	23.3	31.5	6.8	6.8	21.1	20.3	31.6	42.6	3.0	5.3	12.8	20.0	29.8	50.9	2.3	9.1	17	24.2	37.1	46.2
150	70	9.0	20.9	29.9	43.3	62.0	88.9	5.3	11.3	18.8	28.5	56.2	72.9	14.3	20.3	43.7	48.2	81.4	116.0	7.5	18.8	34.7	49.8	78.4	102.5	8.3	28.8	43.2	55.3	97.0	126.5
		9.0	18.7	31.4	49.3	55.3	90.4	5.3	12.0	20.3	26.3	55.6	75.1	13.6	21.1	43.7	46.7	87.4	109.3	6.0	12.1	31.7	48.2	77.6	120.6	7.6	26.5	43.2	59.1	98.5	128.0
		9.0	18.7	29.1	45.5	56.7	86.6	5.3	12.8	19.5	28.5	51.8	70.6	15.1	21.1	44.5	48.2	76.9	119.1	6.0	21.9	33.9	49.8	75.4	111.6	8.3	25.8	40.9	58.3	102.3	134.1
	100	20.2	32.1	43.3	59.0	104.5	146.4	7.5	26.5	33.8	53.3	131.4	148.0	17.3	35.4	64.8	100.2	148.4	149.2	15.1	31.7	20.4	48.2	144.0	148.5	15.9	36.4	57.6	81.1	123.5	149.2
		17.2	29.9	40.3	63.5	123.2	147.8	10.5	22.5	30.8	55.6	147.2	148.7	18.1	33.9	76.1	104.7	149.2	149.2	15.1	31.7	52.0	74.6	128.1	149.3	18.2	27.3	55.3	84.1	137.9	147.0
		17.2	28.4	38.8	57.5	129.2	147.8	10.5	23.3	33.0	53.3	140.5	148.7	18.1	34.7	76.1	104.0	149.2	148.4	12.8	31.7	52.8	78.4	142.5	149.3	17.1	31.9	53.8	82.6	138.6	150.0
	40	4.5	5.2	10.5	8.2	17.2	22.4	1.5	4.5	9.0	14.2	20.2	31.4	3.0	5.3	6.0	9.0	23.3	31.5	3.8	6.8	9.8	12.8	27.8	33.8	3.0	4.5	6.8	12.1	15.2	23.5
		4.5	4.5	12.0	9.0	22.4	20.9	1.5	5.2	9.0	12.7	19.4	29.9	3.0	4.5	5.3	9.0	18.0	28.5	3.8	6.0	9.8	12.8	24.8	32.3	3.0	3.8	8.3	9.9	14.6	22.0
		4.5	4.5	10.5	9.7	22.4	22.4	1.5	5.2	9.0	12.7	18.7	30.6	3.0	4.9	5.7	9.0	22.5	30.0	3.0	6.0	8.3	14.3	27.8	31.6	2.3	4.5	6.8	9.9	14.9	18.9
175	70	10.5	12.0	24.7	35.9	65.0	103.9	6.7	21.7	25.4	38.8	72.5	116.5	6.0	15.0	25.5	36.0	69.0	102.1	6.8	21.8	39.9	43.1	79.0	115.1	5.3	9.9	18.9	40.2	52.3	74.3
		9.7	14.2	26.9	35.1	62.8	100.9	6.0	20.6	25.4	36.6	74.0	115.1	6.0	15.0	21.0	38.3	75.0	113.3	6.8	19.6	36.8	48.9	93.2	117.3	5.3	10.6	20.5	32.1	55.3	90.2
		9.7	14.2	29.1	32.9	61.3	94.9	6.0	19.4	25.4	37.7	73.7	115.8	8.3	10.5	22.5	40.5	79.5	109.6	7.5	20.3	38.4	53.4	86.1	119.6	5.3	9.9	19.7	35.4	53.8	71.2
	100	20.2	32.9	68.3	113.6	146.5	147.2	17.2	35.9	74.7	121.8	147.2	147.2	12.8	26.3	49.5	79.5	146.3	147.8	20.3	39.1	72.9	90.2	148.9	148.1	14.4	25.8	31.1	65.9	106.1	149.3
		20.9	31.4	71.0	109.9	148.0	147.2	15.7	37.4	79.2	124.0	147.9	147.2	12.8	26.3	48.8	81.0	142.6	147.1	18.8	44.4	63.9	91.0	148.9	148.9	14.4	25.8	31.1	66.7	109.1	125.8
		20.6	32.1	69.9	111.8	147.2	147.2	17.9	37.4	81.4	123.3	147.9	147.2	12.0	27.0	50.3	78.0	145.6	147.8	19.6	36.8	66.9	104.5	148.9	148.9	13.6	24.3	35.6	60.6	109.9	137.5
	40	4.5	6.7	10.5	13.5	23.9	25.4	3.7	6.7	8.2	8.9	11.9	14.1	3.8	7.5	12.8	16.6	18.1	23.4	5.2	6.0	7.5	8.2	10.5	16.5	3.0	10.6	6.1	9.2	12.1	21.2
		4.5	6.7	9.0	12.0	20.9	26.9	3.0	6.0	8.9	8.9	9.7	11.9	3.8	6.8	10.6	8.3	17.3	21.9	6.7	6.0	6.5	7.5	10.5	15.7	3.0	11.4	6.8	7.6	12.9	20.4
		4.5	6.7	9.7	12.7	22.4	33.7	3.0	6.7	8.9	9.7	12.6	12.6	3.8	7.5	12.1	16.6	17.7	22.6	6.0	6.0	4.5	7.8	9.7	16.1	3.0	10.6	6.8	9.1	13.6	19.7
200	70	9.0	17.2	28.4	44.1	85.3	129.4	6.7	13.4	17.9	23.8	42.4	67.7	7.5	20.4	37.7	57.3	89.6	93.5	10.5	11.2	19.5	25.4	44.9	68.8	7.6	27.3	19.7	27.3	56.4	97.7
		9.0	18.7	26.9	44.1	83.3	132.4	6.7	13.4	19.3	25.3	46.1	71.4	7.5	18.9	37.0	56.6	89.4	95.0	9.7	11.2	20.9	24.7	44.1	80.0	6.8	29.5	18.9	28.0	53.8	88.6
		9.7	18.0	26.9	40.4	86.8	127.9	6.7	13.4	18.6	24.5	45.4	71.4	7.5	22.6	39.2	51.3	60.3	95.8	10.5	12.0	18.7	23.9	44.1	80.8	7.6	26.5	19.7	28.8	59.0	93.1
	100	18.0	41.9	102.5	144.9	147.4	148.1	17.9	33.5	51.3	93.7	142.8	146.5	14.3	40.7	96.6	144.8	143.3	149.3	20.2	30.7	62.8	90.5	146.6	147.4	18.2	32.6	49.2	75.0	135.5	149.2
		18.0	47.1	85.3	148.9	148.1	148.1	17.9	32.7	53.6	88.5	146.5	146.5	18.1	45.3	95.8	149.3	145.6	149.3	20.9	29.2	66.6	87.5	148.1	148.1	18.9	32.6	51.5	74.2	143.9	149.9
		19.4	46.4	95.7	148.9	148.1	148.1	19.3	35.7	49.1	91.1	144.7	146.5	17.3	46.0	98.0	138.0	145.6	149.3	20.2	29.9	68.8	83.8	148.1	147.7	18.2	33.3	54.5	74.6	139.7	149.9

Table 5. Analysis of variance results for oxygen uptake.

Factor	Significance*	% of Variance
Pressure (A)	XX	0.2
Platen Temp (B)	XX	0.3
Storage Temp (C)	XX	24.8
Storage Time (D)	XX	45.6
AB	XX	2.2
AC	XX	0.3
AD	XX	0.1
BC	XX	1.9
BD	XX	6.4
CD	XX	17.3
Remainder	--	0.9
		100.0

* XX Significant at the 1 percent level

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13. ABSTRACT

The effects of freeze drying pressure, platen temperature, storage temperature, and storage time on appearance of product out of the dryer, rehydration ratio, and oxygen uptake of freeze-dried spaghetti with meat sauce were studied.

It was found that high dryer pressure (1.5 - 2.5 mm of mercury) appeared to cause vacuum drying and that high platen temperatures (175 - 200° F.) caused browning. Low pressure (0.5 mm of mercury) resulted in the best rehydration ratio, whereas low and high plate temperatures gave the best rehydration. While platen temperature and dryer pressure had statistically significant effects on oxygen uptake, their contribution to the total variance observed was small.

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Platens	6					
Temperature	6					
Storage	6					
Time	6					
Rehydration	7					
Oxygen	7					
Absorption	7					
Spaghetti	7					
Meat sauce	7					