

AD A693774

TECHNICAL REPORT

78-17-FL

**FACTORS AFFECTING THE QUALITY
OF FREEZE-DRIED CORN**

by

Abdul R. Rahman
George R. Taylor
Kenneth Miller
Karl R. Johnson

SEP 30 1969
SEP 30 1969

Food Laboratory

This document has been approved for public release and sale; its distribution is unlimited.

Citation of trade names in this report does not constitute an official indorsement or approval of the use of such items.

Destroy this report when no longer needed. Do not return it to the originator.

APPROVED BY	
DATE	DATE REVIEWED <input checked="" type="checkbox"/>
BY	BY <input checked="" type="checkbox"/>
DATE FORWARDED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DESTRUCTION/RETENTION STATUS	
DEST.	RETR. IN/OUT OF FILE

This document has been approved
for public release and sale; its
distribution is unlimited

AD _____

TECHNICAL REPORT
70-17-FL

FACTORS AFFECTING THE QUALITY
OF FREEZE-DEIRED CORN

by

Abdul B. Rahman
George R. Taylor
Kenneth Miller
Karl R. Johnson

September 1969

Project reference
1J6-62708-D553

Series: FL 96

Food Laboratory
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

Foreword

Freeze-dried foods have been accepted by consumers due to their superior quality as compared with foods dried by conventional methods. Their use in the Military operational rations is increasing steadily and is expected to continue upward when the Armed Forces Feeding system shifts more towards convenience foods. Availability of freeze-dried fruits and vegetables such as corn is not assured all year round due to seasonal production and processing.

This work was undertaken to provide data concerning the development of dehydrated food items from frozen commercial products, thus making it possible to procure dehydrated fruits and vegetables needed for military rations at any time of the year.

This work was conducted under Project No. 1J6-62708-D553, Food Processing and Preservation Techniques .

TABLE OF CONTENTS

	<u>Page</u>
List of Tables	v
Abstract	vi
Introduction	1
Experimental Procedure	1
Results and Discussion	2
Conclusion	2
References	3

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1.	Average Ratings (Technological Panel) of Rehydrated Corn as Affected by Treatments and Storage Temperature.	4
2.	Average Acceptance Ratings (Consumer Panel) of Rehydrated Corn as Affected by Treatments and Storage Temperature.	5
3.	Rehydration Ratios (<u>Rehydrated Weight</u>) of Dry Weight Freeze-Dried Corn as Affected by Treatments and Storage Temperature.	6
4.	Texture of Rehydrated Corn as Affected by Treatments and Storage Temperature.	7
5.	Analysis of Variance Results.	8

ABSTRACT

The effect of extended blanching, sulfiting and packaging on the quality of freeze-dried corn prepared from commercially-frozen products and stored for six months at 100°F. and 12 months at 70°F. were investigated. Results indicated that acceptable freeze-dried corn can be prepared from commercial individually quick frozen (IQF) corn by freeze drying without any further treatments and packaged in tin cans under vacuum or nitrogen.

Introduction

The present military purchase document for corn, dehydrated, yellow MIL-C-43449 requires the use of fresh corn for the production of style 2 (dehydrated corn with moisture content not exceeding 3 percent, such as freeze-dried corn). Since the production season of fresh corn is relatively short, procurement of freeze-dried corn is closely related to and significantly affected by the seasonal changes of this item.

Information on the use of frozen instead of fresh corn for the production of freeze-dried corn is limited, incomplete and inconclusive in regard to the effect of thawing, refreezing, reblanching, and sulfiting on the quality of the finished product. Therefore, this work was carried out to determine the effect of such variables on the quality of freeze-dried corn. Work of somewhat similar nature has been conducted on other vegetables. Pettit (1953) reported that green beans which had been frozen prior to heated-air dehydration were greatly superior in acceptability and rehydration characteristics to non-frozen beans. However, when peas are dehydrated by the prefreeze method they are not materially better than when not prefrozen. Moyer, *et. al.* (1959) stated that freezing and thawing increases slightly the drying rates of older peas. He also indicated that increasing the blanch increased the rehydration ratio. Rahman *et. al.* (1969) indicated that acceptable freeze-dried peas can be prepared from commercial individually quick frozen (IQF) peas by thawing, slitting, sulfiting, refreezing, freeze drying and packaging in tin cans under vacuum or nitrogen.

Experimental Procedure

Individually quick frozen (IQF) corn was purchased from the local retail market. The corn was thawed, divided into two lots and one lot blanched for 3 minutes in boiling water. This was an extended blanch (the commercially frozen corn had been blanched prior to freezing) to assure the inactivation of the peroxidase enzyme before freeze drying. The second lot was not blanched.

One-half of each lot was sulfited by dipping in a solution of sodium metabisulfite to yield approximately 500 ppm. Both the lots were refrozen at -20°F . and then freeze-dried with a platen temperature of 120°F . for 16 hours.

Half of the freeze-dried corn for each lot was packed in No. 2- $\frac{1}{2}$ tin cans under nitrogen and the other half under vacuum. Representative samples of each variable were stored at 70°F . for a period of 12 months and at 100°F . for a period of 6 months.

Freeze-dried corn was rehydrated by placing boiling water (approximately 4/1 ratio water to corn by weight) and allowing to stand for 12 minutes in a covered pan. Additional heat was not applied. The texture of rehydrated corn was measured immediately after rehydration with the Lee-Kramer shear press using the regular cell with 30 seconds down stroke. Rehydration ratio was determined by dividing the rehydrated weight of the corn by the dry weight.

Technological panel evaluations for flavor, texture and color were conducted by 10 trained judges, using a 9-point scale (1= extremely poor; 9= excellent). Overall acceptability of the corn was determined by a consumer panel of 32 judges using a 9-point Hedonic scale (1= dislike extremely; 9= like extremely).

RESULTS AND DISCUSSION

Results of the technological panel ratings, consumer panel ratings, rehydration ratios, and texture as measured by the shear press are shown in Tables 1, 2, 3 and 4, respectively. Analysis of variances of these results are shown in Table 5.

Storage of the corn for 6 months at 100°F. or 12 months at 70°F. indicates no significant difference between the various treatments regarding technological ratings, consumer panel ratings and texture. The corn that received extended blanching and was packed in cans under vacuum exhibited significantly lower rehydration ratios than the others. However, this did not affect the consumer or the technological ratings which were acceptable.

CONCLUSION

Freeze-dried corn of acceptable quality meeting the military requirement of storage stability for 6 months at 100°F. can be prepared from commercially frozen IQF corn by freeze drying the frozen corn without any further treatments and packaging in tin cans under vacuum or nitrogen.

REFERENCES

1. Moyer, J.C., D.B. Hand, W.B. Robinson, R.S. Schallenberger and M.R. Pallesen. Factors in raw material and processing influencing the reconstitution of dehydrated peas. Contract No. DA 19-129-QM-584, Quartermaster Food and Container Institute for the Armed Forces, Chicago, Illinois 1959.
2. Pettit, L. A. Dehydration of green beans and peas. Vol. 5, No. 1, p. 20-22. Research and Development Associates, Quartermaster Food and Container Institute for the Armed Forces, Chicago, Illinois 1953.
3. Rahman, A.R., K. Miller, and G. Schafer, Factors Affecting the quality of freeze dried peas. 70-8-FL (FL-94) Food Laboratory, U.S. Army Natick Laboratories, Natick, Mass. Aug. 1969.

Table 1. Average Ratings (Technological Panel) of Rehydrated Corn as Affected by Treatments and Storage Temperature

Treatments	Initial	70° F.		100° F.	
		6 mo.	12 mo.	3 mo.	6 mo.
Blanched, SO ₂ , N ₂	5.7	5.4	5.1	5.3	5.5
Blanched, SO ₂ , Vac	6.1	5.3	5.9	5.6	6.0
Blanched, N ₂	5.8	5.5	5.6	5.1	4.9
Blanched, Vac	6.2	5.5	6.1	6.0	6.2
SO ₂ , N ₂	5.6	5.8	6.4	5.8	4.7
SO ₂ , Vac	6.0	5.3	6.2	5.4	5.8
N ₂	6.7	5.0	5.7	5.1	5.9
Vac	6.3	5.8	6.2	5.7	6.3

Table 2. Average Acceptance Ratings (Consumer Panel) of Rehydrated Corn as Affected by Treatments and Storage Temperature

Treatments	Initial	70° F.		100° F.	
		6 mo.	12 mo.	3 mo.	6 mo.
Blanched, SO ₂ , N ₂	5.5	5.9	4.9	5.6	5.5
Blanched, SO ₂ , Vac	5.6	5.7	5.1	5.7	6.4
Blanched, N ₂	5.3	5.6	5.3	5.5	5.7
Blanched, Vac	5.5	4.8	5.4	5.6	6.2
SO ₂ , N ₂	6.0	5.5	6.0	5.2	5.0
SO ₂ , Vac	5.8	5.7	5.9	6.0	6.1
N ₂	5.7	5.1	5.7	5.1	6.2
Vac	5.9	5.7	6.2	5.6	5.7

Table 3. Rehydration Ratios ($\frac{\text{Rehydrated Weight}}{\text{Dry Weight}}$) of Freeze-Dried Corn as Affected by Treatments and Storage Temperature

Treatments	Initial	70° F.		100° F.	
		6 mo.	12 mo.	3 mo.	6 mo.
Blanched, SO ₂ , N ₂	3.35	3.41	3.82	3.28	3.69
Blanched, SO ₂ , Vac	3.42	3.44	3.71	3.13	3.61
Blanched, N ₂	3.34	3.24	3.42	2.98	3.72
Blanched, Vac	3.43	2.74	3.49	3.02	3.68
SO ₂ , N ₂	3.25	3.40	3.55	3.17	3.67
SO ₂ , Vac	3.26	3.43	3.52	3.18	3.69
N ₂	2.89	3.24	3.38	3.09	3.65
Vac	3.24	3.30	3.46	3.20	3.57

Table 4. Texture of Rehydrated Corn as Affected by Treatments and Storage Temperature

Treatments	Initial	70° F.		100° F.	
		6 mo.	12 mo.	3 mo.	6 mo.
	<u>Lbs.</u>	<u>Lbs.</u>	<u>Lbs.</u>	<u>Lbs.</u>	<u>Lbs.</u>
Blanched, SO ₂ , N ₂	630	795	732	675	800
Blanched, SO ₂ , Vac	810	780	578	666	673
Blanched, N ₂	775	705	711	806	638
Blanched, Vac	825	695	660	610	672
SO ₂ , N ₂	810	644	673	650	647
SO ₂ , Vac	800	735	792	800	620
N ₂	750	621	716	810	598
Vac	800	710	738	770	569

Table 5. Analysis of Variance Results

<u>Factor</u>	<u>Technological Panel Rating</u>	<u>Consumer Panel Rating</u>	<u>Texture Shear Press</u>	<u>Rehydration Ratio</u>
Treatments	N-S	N-S	N-S	N-S
Temperature	N-S	N-S	N-S	N-S
Time	*	N-S	N-S	*
Time x Temperature	N-S	N-S	N-S	*

* = P 70.05

N-S = Not significant at P 70.05

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D		
<i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i>		
1. ORIGINATING ACTIVITY (Corporate author) US Army Natick Laboratories Natick, Massachusetts 01760		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP
3. REPORT TITLE Factors Affecting the Quality of Freeze-Dried Corn		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
5. AUTHOR(S) (First name, middle initial, last name) Abdul H. Rahman, George H. Taylor, Kenneth Miller and Karl H. Johnson		
6. REPORT DATE September 1969	7a. TOTAL NO. OF PAGES 8	7b. NO. OF REFS 3
8a. CONTRACT OR GRANT NO. b. PROJECT NO. LJ6-62708-D553	9a. ORIGINATOR'S REPORT NUMBER(S) 70-17-FL	
c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) FL-96	
10. DISTRIBUTION STATEMENT This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY US Army Natick Laboratories Natick, Massachusetts 01760	
13. ABSTRACT The effect of extended blanching, sulfiting and packaging on the quality of freeze-dried corn prepared from commercially-frozen products and stored for six months at 100°F. and 12 months at 70°F. were investigated. Results indicated that acceptable freeze-dried corn can be prepared from commercial individually quick frozen (IQF) corn by freeze drying without any further treatments and packaged in tin cans under vacuum or nitrogen.		

DD FORM 1473
NOV 68

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Freeze drying	8		4		6	
Frozen foods	9		7		7	
Corn	9		7,4		7	
Military rations	4				4	
Blanching	8		5			
Sulfiting	8		6			
Packaging	8		6			
Quality			7		7	
Thawing	8					
Freezing	8					
Nitrogen	5					
Vacuum	5					
Acceptability					7	