Spring Term, 1942

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Noble Fir
For Refrigerator Use

A Thesis
Presented in Partial Fullfillment
For a Degree of
Bachelor of Sience
In Forestry

Under Supervision of Professor Voorhies
O.S.C. School of Forestry

Approved; _____
Professor of Forestry

Contents

Acknowledgements

Gratitude is here expressed to Miss Bibee, O.S.C. Dining Service, and Professor Wilster and Mr. Neilsen, O.S.C. Dairy School for their splendid cooperation in experimentation, and to Professor Voorhies under whose guidance this work has been accomplished.

Introduction and History

This thesis is written to bring forward the results of experimentation, and with this objective in mind, the presentation of technical matter herin contained will be concise and all inclusive.

In November, 1941, Mr. Dant of Dant and Russell inc. via letter to Professor Voorhies, requested advice concerning probable use of Noble Fir (Abies nobilis) in refrigerator construction. He suggested at that time that the School of Forestry at Oregon State College conduct tests to determine the desirability of such use.

It was not until December, however, that a preliminary report and expense estimate was forwarded to Mr. Dant for consideration. The plan was approved, needed materials supplied, and on February 14, 1942 the experimentation began.

For purposes of clarification and simplicity, the species of Abies nobilis and Picea sitchensis are respectively commented upon as fir and spruce.

Report

jective; The objective of this problem was to determine the desirability of Abies nobilis for refrigerator use.

Materials; Materials necessary for experimentation were - -

1. 50 lineal ft. each of both fir and spruce (4"x½").
2. Zinc coated nails.
3. Glass slides (3"x3"), sixteen
4. Pudding jars, 10 (used to store cream samples)
5. Butter dishes, closed, 2.
6. Cream, 3 quarts.
7. Butter, 13 lbs.
8. Mayonnaise, 1 quart.

Wood was specified to be dry, unfinished, material to present a greater surface area. It was chosen by the Company and shipped to Corvallis. Cream and butter was fresh, high grade material manufactured in the O.S.C. Dairy. The cream was pasturized.

Spruce was chosen to provide comparison (for intensities of odor and taste) with fir, as spruce is the species most used in refrigerators at the present time. Glass provided a standard and absolute base control for the experiment.

Personnell; Personnel necessary for testing butter, cream and mayonnaise samples were Professor Wilster and Mr. Neilsen, O.S.C. Dairy School, and Miss Bibee, O.S.C. Dining service.

Procedure;

I. Box construction - From lumber supplied, 8 boxes each of fir and spruce were constructed having demensions of 4"x4"x8". One nail on each side proved sufficient. The cover for each container was held on by means of a rubber band.

II. Sample preparation; - Butter was cut into ¼ lb. pieces, placed on a glass slide and inserted into a box. It later became necessary to apply taste penetration tests and samples were then cut differently to facilitate accomplishing this objective. Accompanying photographs show these operations clearly.

Butter samples were then subjected to the following combinations of conditions.

Fir boxes

1. Warm, dry, - inspected weekly
2. Cool " " "
3. Cool " " monthly
4. Warm, wet, - inspected weekly
5. Cool " " "
6. Cool " " monthly

Spruce boxes

7. Warm, Dry, - inspected weekly
8. Cool " " "
9. Cool " " monthly
10. Warm, wet, - inspected weekly
11. Cool " " monthly
12. Cool " " monthly

Glass containers

20. Warm, inspected weekly
30. Cool, " "
40. Cool, " monthly

Cream samples were subjected to the following sets of conditions.

Fir Boxes

A. Dry, clear

B. Dry, with slivers immersed

C. Wet, clear

D. Wet, with slivers immersed

Spruce Boxes

E. Dry, clear

F. Dry, with slivers immersed

G. Wet, clear

H. Wet, with slivers immersed

Glass

I. Sample in glass jar (cooled)

Conditions to which mayonnaise samples were subjected were less inclusive due to limited use of this material. They include.

I. Fir, wet box

II. Spruce, Wet box

III. Glass, control

A few remarks concerning the paragraphs included under "Sample preparation" are in order. Cool refers to a refrigerator temperature of 32 degrees F, while Warm indicates a normal room temperature of 70 degrees F. Wet boxes were moistened on the inside before samples were inserted. The above set of conditions subjected wood and food to all environments which

might be normally prevailing in a commercial refrigerator, excepting cream samples which were stored only in cool environments.

After preparation, all samples were placed in their respective environments for a seven day storage period.

III. Testing (tasting); Recording forms were constructed and provided for the testers.** Through a period of four weeks these forms were successively revised to meet changes in procedure. Experimentation took the form as outlined below.

1. Samples were tasted by each person and given an individual rating such as - slighty woody, Pronounced woody ect. Results were compared and samples over which differences of opinion were found, were retasted.

2. Certain sets (2) of samples were compared to ascertain the one most objectionable. At this stage, tests were made for penetration of odor and taste.

3. A general discussion followed the day's experimentation, and comments were usually advanced to improve testing procedure.

4. Notes were kept on each phase of the work as it progressed to record changes in procedure and findings as they became apparent.**

** Recording forms and weekly notes can be found in the appendix.

Photo #1

Two Samples as prepared for the initial test.

Left; - Noble Fir box

- ¼ lb. butter cut flat to expose greatest surface area.

Right; - Sitka Spruce box

- Cream samples, one clear, one holding Spruce slivers.

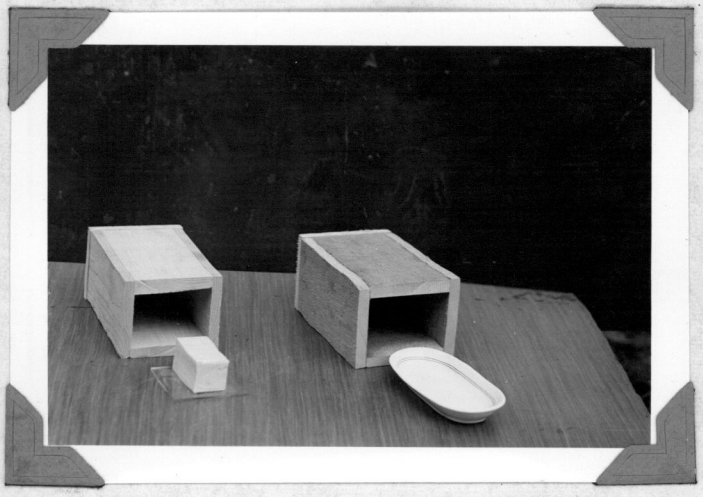

Photo #2

Two samples as prepared for later tests (showing change in procedure)

Left; - Noble Fir box

- ¼ lb. butter cut to facilitate penetration tests

Right; - Sitka Spruce box

- Container used for cream samples when slivers were discarded

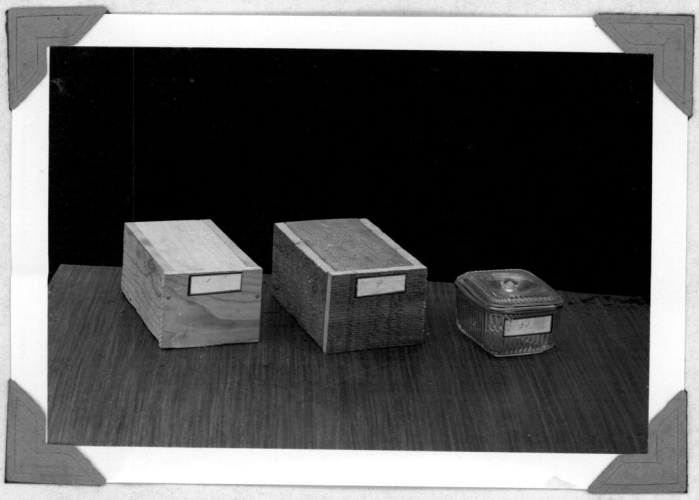

Photo #3

Three of the seventeen samples as they appeared while in respective environments.

Left to right;

1. Noble Fir box
2. Sitka Spruce box

Note; These contained either cream or butter samples

3. Glass butter container.

Results

The following pages contain a tabulation of experimentation results.

Legend;

vsw - Very slightly woody

sw - Slightly woody

w - Woody

pw - pronounced woody

dw - Definitely woody

Numbers and letters in comparison tests correspond to numbered descriptions found in tabulated sample results.

Tabulated

Butter Comparisons Results

Samples (sets) Compared	Worst Samples per week 1	2	3	4	Average
1-4	-	4	4	4	4
2-5	5	5	5	5	5
7-10	-	10	-	10	10
8-11	-11	11	11	11	11 (pitch)
1-2	1	1	1	1	1
1-7	-	1	1	1	1
2-8	2	2	8	2	2
4-10	4	4	4	4	4 (10 pitch)
5-11	5	5	5	5	5 (11 pitch)
7-8	-	8	-	8	8
3-6	-	-	-	6	6
9-12	-	-	-	12	12
3-9	-	-	-	3	3
6-12	-	-	-	12	12

Note; Numbers used above correspond to those described in "Tabulated Butter Sample Results".

Tabulated

Butter sample Results

Samples			Scores per Weeks				
			1	2	3	4	Average
Fir - Dry							
1. Warm,	inspected	weekly	w	pw	sw	sw	sw
2. Cool,	"	"	pw	sw	sw	w	sw
3. Cool	"	monthly	-	-	-	dw	dw
Fir - wet							
4. Warm,	inspected	weekly	dw	pw	pw	pw	pw
5. Cool	"	"	pw	sw	pw	pw	pw
6. Cool	"	monthly	-	-	-	pw	pw
Spruce - dry							
7. Warm,	inspected	weekly	old	old	-	old	old
8. Cool	"	"	old	sw	sw	sw	sw
9. Cool	"	monthly	-	-	-	stale	stale
Spruce - wet							
10. Warm,	inspected	weekly	pitch	vsw	vsw	pitch	pitch
11. Cool	"	"	pitch	pitch	pi	w	pitch
12. Cool	"	Monthly	-	-	-	pw	pw
Glass							
20. Warm,	inspected	weekly	old	old	old	old	old
30. Cool	"	"	ok	ok	ok	ok	ok
40. Cool	"	monthly	-	-	-	stale	stale

Tabulated

Cream Sample Results

Samples	Scores per Weeks				
	1	2	3	4	Average
Fir					
A. Dry, Clear	dw	sw	dw	dw	dw
B. Dry, Slivers	w	pw	sw	-	w
C. Wet, Clear	w	vpw	dw	pw	pw
D. Wet, Slivers	dw	dw	pw	-	dw
Spruce					
E. Dry, Clear	w Stale	sw Stale	sw	sw	sw Stale
F. Dry, Slivers	w Stale	vsw	sw	-	sw Stale
G. Wet, Clear	sw	sw	sw	dw	sw
H. Wet, Slivers	w Pitch	Pitch	Ok	-	Pitch
Glass					
I. Glass container					
Base - -	Ok	Ok	Ok	Ok	Ok

Tabulated

Cream Sample Comparisons

Sample (sets) Comparisons	Worst Samples per Weeks 1	2	3	4	Average
A-B	A	B	A	-	A
C-D	-	C	D	-	-
A-C	-	C	A	C	C
E-F	F	E	No Dif	-	-
G-H	-	H-Pitch G-Woody	"	G	-
E-G	-	E	No Dif	G	-
A-E	A	A	A	A	A
B-F	B	B	B	-	B
C-G	C	C	C	C	C
D-H	D	D	D	-	D

Blank spaces were caused by the incompatibility of testers in deciding upon the worst sample.

Tabulated

Mayonnaise Sample Results

Samples	Scores per Weeks				
	-*1	2	3	4	Average
I. Fir,Wet --------	-	-	dw	dw	dw
II. Spruce,Wet ----	-	-	sw	sw Pitch	sw Pitch
III. Glass --------	-	-	Ok	Ok	Ok

Discussion; Four weeks of experimentation produced conclusive evidence. The following conclusions can be drawn from data presented on the previous pages.

1. Fir imparts odor and taste to foods much more readily than does Spruce.

2. Food in moist fir boxes was affected more severely than that in fir dry boxes.

3. Food in warm environments was more severely affected than that subjected to cool temperature. This was due, in all probability to -

a. Increased rate of chemical changes within food stored in warm temperatures.

b. Decreased volatility of wood resins when subjected to cool temperatures.

4. Wet spruce transmits pitchy odors and tastes to foods and if stored for some time, results in a more disagreeable pitchy taste than the woody flavor of food stored with fir for the same length of time. However, samples were limited in number, and perhaps the spruce lumber used contained an abnormal amount of resin.

5. Penetration of odor and taste of both species into butter, cream and mayonnaise samples was identical for each type of material, and progressed into the surface layers only. As storage time increased, penetration increased also. Butter was contaminated ¼ inch after one week and spoiled to a

maximum of ½ inch after one month

Summary and conclusion; As has been adequately demonstrated, Noble fir definitely produces disagreeable odors and tastes in foods subjected to it. Furthurmore, transmission of woody taste increases when fir is wet or warm.

Any refrigerative unit is subjected to changes in moisture content and temperature, particularly when defrosted. Therefore, fir should not be used in the interior of a unit when contact with food is eminent.

Reference is made to th bulletin discussing butter boxes (bibliography) in which butter samples were first wrapped securely in parchment and little affected by storage in wood containers. This would endicate that fir could be used for refrigerator structural members or insulative lining if such material was kept sealed from contact with air circulating around stored foods.

Another possibility lies in treatment of wood with paraffin to produce non odorous or tasteless material. Wood members are dipped for a period of twenty min. in wax, heated to a temperature of 350 degrees Fahrenheit. This process drives out volitile oils and throughly impregnates wood with wax. A detailed description of this process is found in the bulletin on butter manufacturing and testing by G.H.Wilster, O.S.C. Dairy School. (found in bibliography)

Bibliography

Bibliography

1. Davis, E M and G C Morebeck, "Tests of Woods for Butter Containers With Reference to Imparting Taste and Odor", U.S.D.A. Miscel. Pub. # 250

2. Wilster, G H, "Marketing Oregon Butter and Cheese", O.S.C. Coop. Extension Service, Bul. # 541, 1940

3. Wilster, G H, "Practical Butter Making" (A manual for Butter makers), Corvallis, O.S.C. Coop. Assn, 1937

Appendix

Noble Fir Experimentation Notes

February 19, 1942

Placed butter and cream samples in Noble fir and Sitka spruce boxes. Cooled samples were stored on 2 shelves of refrigerator #4 in O.S.C. Memorial Union. Warm samples were stored in the wood products class room - Forestry school basement.

February 26, 1942

At 3 PM samples were removed from boxes and placed with glass slides upon numbered peices of parchment paper. Dr. Wilster and Mr. Neilsen, O.S.C. Dairy school and Miss. Bibee tested the samples. The following deficiencies were noted in experimentation procedure.

1. Warm samples were discriminated against and were har d to test. It was suggested that they be cooled a few hours previous to tasting.

2. Samples should have been arranged in 2 nearly identical groups with a control sample for each group.

3. A method of comparing samples hadnnot been worked out

4. There was no control on cream samples.

February 27, 1942

Samples were replaced and stored as usual. One extra jar of cream was wrapped with parchment and stored away from contamination to provide a control. Also, 2 samples of control butter instead of 1 was stored to provide controls for both sets.

March 5, 1942

Two hours before testing, warm samples were removed to the refrigerator for cooling. Dr. Wilster, Mr. Neilsen, and Miss. Bibee assisted by Mrs. Doughtery tasted samples. They were favorably impressed with the new recording forms and method of comparing samples. Results of the last testing were furthur borne out -

1. Wet wood of both species produces more disagreeable tastes and odors.

2. Noble Fir taste and smell in foods is much more aggressive in nature than that of spruce.

3. Wet spruce produces a pitchy taste which penetrates less than fir's woody odor.

To furthur test penetration, it was suggested that samples be cut thicker. Use of mayonnaise was discussed. Due to tasters unfamiliarity with it, it was decided to keep the cream samples and only put in 2 additional boxes containing mayonnaise samples.

March 9, 1942

Samples were replaced as per usual. Two extra boxes were constructed and 2 mayonnaise samples were inserted - 1 sample for spruce and the other for fir. Both boxes were wet.

March 16, 1942

Samples again were tested by Prof. Wilster, Mr. Neilsen and Miss Bibee in the customary manner. The following points were discussed.

1. Little difference in penetration of either fir or spruce odors.

2. A marked agreement of testers showed an overwhelmingly bad taste of fir samples against those of spruce.

3. Mayonnaise picked up wood flavor fairly well, but experimentation with it was not increased in scope because testers were unfamiliar with the essential mayonnaise taste.

4. Mayonnaise and cream samples had too little surface area to permit extensive testing. Taste did not penetrate below the surface layer. Jars with increased surface area were recommended for future use with these materials.

Note: Notes as originally written in long-hand are to be found in report copies sent to O.S.C. Forestry School and Dant and Russell Inc.

Recording Sheet

Tester _____ Date _____

Butter

1	2	3	4	5	6	7	8	9	10	11	12	20	30	35	40

P - indicates need for penetration Tests.

Indicate Worst Sample

	1+4		1+7
P	2+5	P	2+8
	7+10		4+10
P	8+11	P	5+11
	1+2		7+8

Cream

A	B	C	D	E	F	G	H	I	J

Indicate Worst Sample

	A+B		E+G
	C+D		A+E
	A+C		B+F
	E+F		C+G
	G+H		D+H

Mayonnaise

I	
II	
III	

additional - 42 Work

3+6
9-12
3+9
6+12

3/2/42

Noble Fit Work Sheet #1

Sample Arrangement For Testing

• Butter

= 1 - 5 - 7 - 11 - 30 - 3 - 9
2 - 4 - 8 - 10 - 35 - 6 - 12

Cream + Mayonnaise

= A - D - E - H - ~~X~~ i
B - C - F - G - ~~X~~ J

Comparisons necessary

Butter =

1+4 -		1+7
2+5 -		2+8
7+10 -		4+10
8+11 -	11	5+11
1+2 -		7+8

Cream + Mayonnaise

= A+B ✓ E+F ✓ A+E ✓
C+D — 6+H Patch — B+F
A+C ✓ E+6 ✓ C+6 ✓
D+H Patch

Assembly Recording Sheet.

comparisons

Worst sample recorded

	1st Week	2nd Week	3rd Week	4th Week	additional	
1+4		4	4	4	3+6	6
2+5	5	5	5 inside + out	5	9+12	12
7+10		10	Mic got into sample Box + spoiled	10	3+9	3
8+11	11 - Pitchy	11	11 inside + out.	11	6+12	12.
1+2		1	1	1		
1+7	7	1		1		
2+8	2	2	8 only on surface	2		
4+10	4-(10 Pitchy)	4	4	4 (10 Pitchy		
5+11	5 (11 Pitch-More)	11-Pitch on outside 5- Wood Pro. Thru-out	5 inside + out.	5		
7+8		8		8		

Records not completely made out 1st Week

	1st Week	2nd Week	3rd Week	4th Week		
A+B	A - question ?	B	A			
C+D		C	D			
A+C		C	A	C		
E+F	F	E	No Difference			
G+H		H - Pitch G - Most woody	" "			
E+6		E	" "	6		
A+E	A	A	A	A		
B+F	B	B	B			
C+6	C	C - Pronounced	C	C		
D+H	D	D Pronounced	D			

5 Answers were discarded

Assembly Recording Sheet
(Individual Samples)

Butter

Week	1	2	3	4	5	6	7	8	9	10	11	12	20	30	40
1	Woody	Pro. Woody	—	Def. Woody	Pro. Woody	—	Old	Old + Stale	—	Slight Pitch	Pitchy	—	Stale	O.K.	—
2	Pro Woody	Sl. Woody	—	Pro. Woody	Sl. Woody	—	Stale	Sl. Woody	—	Very Sl. Woody	Pitch	—	Stale	O.K.	—
3	Sl. Woody	Sl. Woody	—	Pro Woody	Pro Woody	—	—	Sl. Woody	—	Very Sl. Woody	Pitch	—	Stale	OK	—
4	Sl. Woody	Woody	Def Woody	Pro. Woody	Pro. Woody	Pro Woody	Old	Sl. Woody	Stale	Pitch	Woody	Pro Woody	Stale	OK	Stale

Cream + Mayonnaise

Cream

Week	A	B	C	D	E	F	G	H	I
1	Def. Woody	Woody	Woody	Def. Woody	Woody + Stale	Old + Woody	Slightly Woody	Old	OK
2	Sl Woody	Pro. Woody	Very Pro. Woody	Def. Woody	Sl. Woody + Stale	Very Sl. Woody	Sl. Woody	Pitch	OK
3	Def. Woody	Sl. Woody	Def. Woody	Pro. Woody	Sl. Off	Sl. Off	Sl. Off	OK.	OK
4	Def. Woody		Pro. Woody		Sl. Woody	~~Def. Woody~~	Def. Woody	OK.	

Mayonnaise

	I	II	III
1	Def. Woody	Sl. Woody	OK
2	Def. Woody	Sl. W (Pitch)	OK