

T H E S I S

on

Effects of Feeding Turnips on the Flavor of Butter

O R E G O N A G R I C U L T U R A L C O L L E G E

In Partial Fulfillment of the Requirements

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by

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the Flavor of Butter

Especially after storage.

Large amounts of turnips (*Brassica rapa*) are grown in Oregon as feed for dairy cows, especially in the Lower Columbia Valley. So far no bad effects on the flavor of the butter or other products have been reported.

Some years ago it was customary to grow large amounts of turnips as feed for dairy cows in Humboldt County, California. A very noticeable turnip flavor was said to be imparted to the butter. This flavor was more noticeable after storage. Because of this flavor the State Department of Agriculture, issued a ruling forbidding the farmers to feed turnips to dairy cows.

As most of the butter made in that part of Oregon where turnips are fed freely is sold at once and not placed in storage for more than two weeks, it was thought advisable to carry on an experiment under carefully controlled conditions to determine;

1. If the varieties of turnips grown in Oregon would cause the characteristic turnip flavor in butter.
2. If the soil or climate where the turnips were grown had any effect on the flavor produced in butter.
3. What particular substance or substances in the turnip produces the flavor in the butter.
4. If Bacterial action has any effect on the flavor produced in the butter after feeding turnips.

According to C. J. Babcock,⁽¹⁾ when fed on hour before milking, turnips produce objectionable flavors and odors in milk. These flavors were more pronounced in the cream than in the milk. If fed immediately after milking 30# per day had very little effect on the flavor of the milk.

Hyslop⁽²⁾ of the Oregon experiment station states that 50# or more of turnips fed daily will cause a turnip flavor in milk even though fed after milking.

An article in the Berz Norges Landbr. by Flaskaler Virks⁽³⁾ states that turnips fed to Norwegian cows improved their milk for making Swiss cheese.

In an article published in Le Lait, Professor Orla Jensen⁽⁴⁾ says that the turnip flavor in milk is due to volatile oil of mustard liberated from the mother substance or glucoside by the action of non spore forming, gelatine liquifying bacteria. That the bacteria may get into the milk from manure or from water.

New Zealand reports considerable trouble with turnip-flavored butter. W. G. K. Wigh, editor of the "New Zealand Dairyman" says in a letter received from him by the author, "The turnip flavor is very often found after the butter has been in store for a month or two." He stated it was customary for the farmers to turn the cows in to the fields of turnips and leave them for indefinite periods.

Preliminary Experiment

Two groups of three cows each were used. One group was used as a control. Both groups received the same basic ration of, mill run, ground barley, cocoa nut meal, and oat and vetch hay. For succulence the control group received 20 pounds of corn silage per cow, which was fed immediately after milking.

For succulence the experimental group received varying amounts of turnips as follows:

1. For three days twenty pounds of turnips daily, in two feedings fed immediately after milking. On the third day the cream from both groups was churned and three samples of each lot of butter were placed in storage.

2. For the next three days thirty pounds of turnips daily in two feedings fed immediately after milking. On the third day the cream from each group was churned and three samples from each lot of butter were placed in storage.

The above procedure was repeated every three days, increasing the ration of turnips ten pounds until the experimental cows were receiving fifty pounds of turnips daily.

Then for three days the experimental cows were fed fifty pounds of turnips daily one hour before milking and samples of cream taken daily for churning.

The turnips used in the above experiment were a mixture of "cow horn" and "strap leaf purple top" varieties. They were grown in the Willamette Valley near Monmouth, Oregon.

They were planted the early part of July. They were 4.
pulled as fed and both roots and tops were fed to the cows.

The cream was churned in "Daisy" glass churn, using about three quarts for a churning. It was churned at a temperature that would cause the butter to come in about thirty minutes. The butter was removed to a bowl and worked with a butter ladle to incorporate the salt.

The samples of butter were stored in a refrigerator which varied in temperature from zero degrees F. to ten degrees F. above zero. They were removed from storage and scored by expert butter judges at periods of one week and one month. The plan was to score them again in three months and six months but owing to a break down in the refrigerating machinery the remaining samples were lost.

The butter was packed in enameled tin cans (No. 1 size) and covered with parchment paper.

Below is a tabulation of the scores:

Tabulation of Experiment One

5.

Daily amt. of turnips	No. of churning	Date of churning	Score at 1 week	Score at 1 month	Score at 3 months	Score at 6 months
0	1	10/19/25	89½ Flat	88½ Tallowy		
0	1'	10/19/25	88½ Unclean	88		
20#	2	10/20/25	90 Lack of cooling	89		
0#	2'	10/20/25	89½ Foreign	89		
30	3	10/23/25	90½ Foreign	89½ Flat		
0	3'	10/23/25	92 Foreign	91 Unclean		
40#	4	10/28/25	88½ Crumbly Sticky	85 Rancid Foreign		
0	4'	10/28/25	91	84½ Rancid Coconut		
50#	5	10/31/25	90½ Crumbly	86 Rancid Coconut		
0	5'	10/31/25	89	86 Coconut		
50#	7	11/8/25	91½ Flat			
0	7'	11/8/25	91 Flat			
50#	8	11/10/25	90			
0	8'	11/10/25	88½ Unclean			
50#	9	11/11/25	89½ Unclean			
0	9' -	11/11/25	88 Unclean			

Tabulation of Experiment One Continued

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Daily amt. of turnips	No. of Churning	Date of Churning	Score at 1 week	Score at 1 month	Score from 3-6 months
50#	10	11/12/25	91 Flat		
0	10'	11/12/25	87 Unclean		

Experiment Two

7.

In the second experiment turnips were secured from the John Jacob Astor Experiment Station at Astoria. Both tops and roots were pulled and shipped to Corvallis in 1000# lots. The procedure was changed in that the cows were fed 30# of turnips daily for three days and then a sample of cream was saved for churning. The ration of turnips was then increased until the cows were eating all the turnips they would and then daily samples were taken.

The samples of cream were saved and churned and the butter scored as before.

Table follows:

Experiment Two

8.

Daily amt. of turnips	No. of churning	Date of churning	Score 1 week	Score 1 month	Score 3-6 months
30#	11	11/25/25			
0	11'	11/25/25	90½		
	12	12/2/25			
0	12'	12/2/25	84 Foreign		
	13	12/3/25	86 Coconut		
0	13'	12/3/25	87 Coconut		
	14	12/5/25	88 Kale		
0	14'	12/5/25	88 Kale		
	15	12/7/25	90 Coconut		
	16	12/11/25			
0	16'	12/11/25			

In this experiment cowhorn and green globe turnips were used. These samples were lost when the refrigerating machinery broke down.

In the third experiment turnips were planted near Corvallis in May and allowed to ripen through the hot summer months. They were badly infested with root maggots. They did not grow very large, one to two inches in diameter. They were rather dry and had a strong flavor. The cows did not relish them very well, 30 to 40 pounds per day being all they would eat.

In the first part of the experiment the cows were fed all the turnips they would eat about one hour before milking. The cream was churned and the butter placed in storage as before, except that a "barrel" churn was substituted for the "Daisy" churn and twenty-five pounds or nearly three gallons of cream was used. This butter was worked in a Reid's Original Philadelphia butter worker.

With the exception of samples number VI and VII all the cream had a sweet clean flavor when separated. Sample numbers VI and VII had a distinct turnip flavor when separated. This flavor seemed to carry over into the butter but to grow weaker rather than stronger during the storage period.

Below is a table showing the scores and criticisms of the butter.

Tabulation of Experiment Three

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Churnings made with cream from turnips grown at Corvallis in the summer

Score and criticism after butter in storage
for

No. & Date	Conditions of Feeding	One Week	One Month	Three months	Four Months	Seven Months
I 7/20/26	All turnips cows would eat (40# per day) one hour before milking. Cream sweet when churned.	Waxy 91	Greasy Cowy Light Salt Feed Odd Flavor	89	91	91 87 rancid
II 7/20/26	Check Sample Sweet Cream	X	X	88½	90 Woody	87
II 7/26/26	All turnips cows would eat (40# per day) one hour before milking. Cream sweet when churned.	91½	90 Cowy	90½	90	87
III 8/3/26	Same as II 20% Starter Added	X no score rancid	93½ Storage Flavor	X	92½	80 rancid
IV 8/3/26	Check Sample Sweet Cream	X no score rancid	91½ Cowy Rancid	89 Storage	88 Flat	88 Storage
V 8/5/26	All turnips cows would eat (40# per day) 1 hr. before milking. Cream held 2 days at 70 F.	90 Old cream Metallic Flat	90 Metallic	86 Metallic	88 Feed	80

Tabulation of Experiment-Three (continued)

11.

No. & Date	Conditions of Feeding	One Week	One Month	Three Months	Four Months	Seven Months
VIII 8/11/26	All turnips cows would eat (40# per day) immediately <u>after</u> milking. Sweet cream. 20% starter added.	90	91 Feed	90	91	88
IX 8½13/26	Same as VIII But cream held 30 hrs. at 70F. and .65% acidity developed. Neutralized to .25%.	X	89 Cowy	89 Feed	88 Foreign	82
12 8/17/26	Turnips were distilled and the distillate fed to cows. Cream sweet.	X	91½ Storage	88 Old cream	90 Metallic	84 Foreign

Note: All samples were pasteurized by holding at 150 F. for 30 minutes. They were cooled to 40 F. and held at least 2 hours before churning.

It is noticeable that with the exception of sample number VI, all the samples scored practically the same as the two check samples numbers 1 and 4.

Samples numbered V, VI, and IX were held, as raw cream, at 70 F. until a high degree of acidity had developed. The scores of these three samples average slightly lower than scores of the other samples.

Taken as a whole these scores would indicate that the turnip flavor, even when detected by the judges was not very objectionable.

During the summer an attempt was made to isolate the substance in the turnip which gives it the turnip flavor. The turnips were distilled with steam, and the distillate extracted with ether. The ether was then evaporated. A very minute amount of substance was left which certainly had the turnip flavor and odor, but this substance soon evaporated. It was in such minute quantities and so unstable that it was practically impossible to do anything with it.

This experiment was carried on at Astoria where the whole herd of pure bred Guernsey cows, belonging to the John Jacob Astor Experiment Station were used. They were fed all the turnips they would eat about one hour before milking, with the exception of sample number 14, where the turnips were fed after milking. All the cream had a feed flavor except sample 14. All the butter, except sample number 14, had a distinct turnip flavor when fresh churned. This flavor was very objectionable. When the butter was scored one week after churning, having been held in storage at zero degrees F. to ten degrees F. above zero. This objectionable flavor was practically all gone as can be seen from the scores. The flavor seemed to have been "frozen out," and it did not reappear to any extent during storage.

Experiment Five

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Churnings Made at Astoria

No. & Date	Conditions of feeding. All cream past at 150F for 30 minutes.	Scores and criticism 1 week after churning 11/5/26	Score & criticism 1 month after churning 12/5/26	3 months after churning 2/5/27	6 mos. 5_5_27
14 10/25/26	Turnips fed after milking. All the cows would eat. Approx. 60# per day. Sweet Cream	92 lightly scorched Past	Judge 1 90 Judge 2 92	Judge 1 89	91
15 10/27	Turnips fed before milking. 60# per day. Cream held over night acidity .6 Neut. to .2 Had a slight "off" flavor.	91½ Course	Judge 1 89 Judge 2 91½	89	91
16 10/27/26	Same as 15. but churned same day sweet cream. Had a slight off flavor. Butter had a distinct turnip flavor.	92 Slight Feed Very Objection_ able.	90 92	89	91
17 10/29/26	60# Turnip fed before milking Cream held over .5% acidity. Neut. to .2 Slight off flavor.	91 Old cream	88 coarse Neutralizer 89 Turnip	86	89
18 10/29/26	60# turnip before milking. Churned same day. Sweet cream. Butter had a turnip flavor Had a distinct off flavor.	90 off. flavor Turnip	90½ 91½	89	91

Experiment Five Continued

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No. & Date	Conditions of feeding. All cream past at 150 F for 30 minutes.	scores and criticism one week after churning 11/25	Score & criticism one month after churn- ing 12/5/26	3 months after churn- ing. 2/5/27	6 months 5/5/27.
19	60 # turnips before milking. Cream brought to Corvallis and churned. Acidity .6% over Neut. Butter had slight feed flavor.	91 Neut. Feed Flavor	89½ Course Neut. 89 Off	87 Turnip	89

As the turnip flavor had been so strong in the butter churned at Astoria it was thought that the feeding of rotten turnips might be the cause of it, as they were having some trouble with rotten turnips at Astoria. Eight barrels were filled with turnips and tops and placed in a warm room and allowed to rot. These were then fed to the cows at the rate of 60 pounds per day, one hour before milking. All the samples of cream had a feed flavor and all of the samples of fresh churned butter had a distinct turnip flavor. This flavor also seemed to "freeze out" so that it was not nearly as strong after the butter had been in storage for a week at zero degrees F. to ten degrees F. above zero. In fact, up to three months the butter seemed to improve with storage.

Tabulation of Experiment VI

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Rotten Turnips

20	Innoculated turnips to one 12/12/26 cow. Not past.	Scored as good quality "dairy" butter Jan. 7, 1927		
22	Check sample no turnips fed	Scored Feb. 3 '27		Scored April 6 '27
1/12/26		91½	91	92
23	60# rotten turnips 1 hr. before milking cream slightly off turnip flavor in butter.	88	88	91 slight feed
24	60# rotten cowhorn turnips. Cream very slightly off flavor butter had distinct turnip flavor when churned.	88	90	91
		Turnip	Turnip	

Note: All samples except number 20 pasteurized by being held at 150 F. for 30 minutes. Then they were cooled to 40 F. and held at least two hours before churning.

1. Turnips, even if fed in excessive amounts, when fed immediately after milking do not produce an objectionable flavor in the butter.

2. Turnips, when fed in excessive amounts one hour before milking may produce an objectionable flavor in the fresh butter. This flavor decreases after the butter has been in storage for a week i.e., it partially "freezes out."

3. Rotten turnips, when fed in excessive amounts, one hour before milking produce an objectionable flavor in the fresh butter. This flavor decreases after the butter has been in storage for a week at about zero degrees F.

4. Turnips can be recommended as a succulent feed for dairy cows if fed immediately after milking.

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(20)

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