



THE OCCURANCE OF STAPHYLOCOCCUS BACTERIA  
IN CREAM PIE FILLINGS

I.D. 499

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## INTRODUCTION:

One of the major causal agents in food poisoning is Staphylococcus aureus. This gram-positive organism flourishes in many foods; especially mammalian proteins such as meat or milk (4). For this reason, foods with a milk and egg base (cream pie fillings for example) are often responsible for outbreaks of food poisoning.

Staphylococci need a temperature range of 50-120°F. to multiply well. The temperatures in most home kitchens fall into this temperature range. Most refrigerators are kept below 50°F. and so should be comparatively safe storage places. Miller and Smull (3) found that the more quickly cream pie fillings were cooled below 50°F., the lower the bacterial count.

The housewife runs the greatest risk of food poisoning when she prepares large quantities of food which must be stored for some time before consumption.

Commercial food handlers must take greater precautions than the housewife as they are almost always dealing with large quantities of food and are serving large numbers of people.

In this project, cream pie fillings will be studied. To lessen expense, dry, skim milk will be used. Walker and Harmon (5) showed that the rate of growth of Staphylococcus aureus was the same in skim milk as in whole milk.

## PROBLEM

The problem of this project is to determine what types of bacteria are commonly found in cream pie fillings ( which have been prepared under ordinary sanitary conditions in a home kitchen), and to see how often staphylococci are present. If staphylococci are found, we will note when they were first found.

## PROCEDURE

Cream pie fillings were made from a standard recipe and placed in six-inch custard cups. The six-inch size was chosen so as to be large enough to simulate an actual pie, yet small enough to cut down on the amount of filling necessary for each one. As the filling was the product being tested, no crust was used. All fillings were prepared in a home kitchen and stored there-- either on the counter or in the refrigerator.

Twenty-four hours after preparation, approximately one-fourth of the filling was removed, mixed together, and a small portion of this smeared on an agar plate. This procedure was repeated at forty-eight and at seventy-two hours.

Any growth on the plates was transferred to agar slants and incubated forty-eight hours. Slides were made of the colonies and treated with Gram stain. The slides were placed under a microscope and observed as to form, grouping, and Gram reaction. The results were entered on the chart found in the section of this paper "Results and Discussion".

Growths which were found to be fungi were discarded.

RECIPES USED IN EXPERIMENT:

Cream Pie Filling

$\frac{1}{4}$  cup sugar  
1/6 tsp. salt  
2 T. corn starch  
1-1/8 cup milk, scalded  
1 egg yolk, beaten  
 $\frac{1}{2}$  tsp. vanilla  
3/8 T. butter

Mix dry ingredients. Add scalded milk and cook over medium direct heat until mixture boils. Boil one minute. Add half the hot mixture to the beaten egg yolk slowly. Combine this with the rest of the hot mixture. Cook over hot (simmering) water for three minutes. Remove from heat and add butter and vanilla.

Meringue

1 egg white  
1/8 tsp. cream of tartar  
2 T. sugar

Beat egg white and cream of tartar until foamy. Add sugar, one tablespoon at a time, beating well after each addition. Beat until stiff peaks are formed. Spread completely over filling and bake at 400°F. for eight minutes.

## RESULTS AND DISCUSSION

Staphylococcal organisms were found in eight of the twelve trials. Contamination occurred in the same number of covered trials as uncovered. In only one instance, however, did the organism appear in twenty-four hours in the covered trials. In the uncovered trials, the organism was present after twenty-four hours in three of the four times it appeared. One of the eight trials yielded a Gram-negative Staphylococcus, while the seven other colonies of Staphylococci were Gram-positive.

Staphylococcus appeared in three of the four trials in which the meringue was placed directly on the hot filling and baked. It also appeared in three of the four trials in which the meringue was placed on cooled filling and then baked. Staphylococcus occurred in two out of four trials in which no meringue was used. More trials would have to be run to see if this difference is significant.

Staphylococcus occurred in three of the six uncovered trials, and in three of the six covered trials. Diplobacillus occurred only once - in an uncovered trial. Streptococcus occurred twice - once in a covered trial, and once in an uncovered trial.

Contamination occurred as often in refrigerated trials as in the unrefrigerated ones. However, the organism did not show up as soon in the refrigerated trials, indicating that the lower storage temperature retarded the growth of the bacteria.

The results of this experiment are tabulated in chart form on the two following pages.

MICROSCOPIC ORGANISMS FOUND IN WHIPLES OF CREAM PIE FILLING  
PREPARED AND STORED UNDER VARIOUS CONDITIONS

PREPARATION AND STORAGE	24 HOURS		48 HOURS		72 HOURS	
	BACTERIAL FORM	GRAM REACTION	BACTERIAL FORM	GRAM REACTION	BACTERIAL FORM	GRAM REACTION
Meringue on hot filling. Stored on counter, uncovered.	Staphlococcus Streptobacillus	- +	Staphlococcus Streptobacillus	- +	Staphlococcus Streptobacillus	- +
Meringue on hot filling. Stored in refrigerator, uncovered.	Diplobacillus Staphlococcus	+ +	Diplobacillus Staphlococcus	+ +	Diplobacillus Staphlococcus	+ +
No meringue on filling. Stored on counter, uncovered.	Staphlococcus	+	Staphlococcus	+	Staphlococcus	+
No meringue on filling. Stored in refrigerator, uncovered.			Streptobacillus	+	Streptobacillus	+
Meringue on cooled filling. Stored on counter, uncovered.	Streptobacillus	+	Streptobacillus	+		
Meringue on cooled filling. Stored in refrigerator, uncovered.	Streptococcus	+	Streptococcus	+	Staphlococcus	+

PREPARATION AND STORAGE	24 HOURS		48 HOURS		72 HOURS	
	BACTERIAL FORM	GRAM REACTION	BACTERIAL FORM	GRAM REACTION	BACTERIAL FORM	GRAM REACTION
Meringue on hot filling. Stored on counter, covered.	Staphlococcus	+	Staphlococcus	+	Staphlococcus	+
Meringue on hot filling. Stored in refrigerator, covered.	Streptobacillus	+	Streptobacillus	+	Streptobacillus	+
No meringue on filling. Stored on counter, covered.	Streptobacillus	+	Streptobacillus	+	Streptobacillus	+
No meringue on filling. Stored in refrigerator, covered.	Streptobacillus	+	Streptobacillus Staphlococcus	+ +	Staphlococcus	+
Meringue on cooled filling. Stored in refrigerator, covered.			Streptococcus	-	Staphlococcus	+
Meringue on cooled filling. Stored on counter, covered.			Staphlococcus	+	Staphlococcus	+



## SUMMARY

Twelve six-inch pies were prepared in this experiment. Four had meringue placed directly on the hot filling and baked. Four had meringue placed on cooled filling and then baked. Four received no meringue. These were stored both on the counter and in the refrigerator. Some fillings were covered; some were not.

Samples were taken at twenty-four, forty-eight, and at seventy-two hours. The samples were observed for bacterial growth. Staphylococcus (the organism of primary interest in this experiment) was found in eight of the twelve trials. Other organisms present in the fillings were Streptobacillus, Diplobacillus, and Streptococcus.

## CONCLUSIONS

The results of this project indicate that staphylococcal bacteria are common in the home and are a potential source of food poisoning.

The tests run in this experiment only show that the organisms were present at certain times; not how many or the amount of toxin present.

The results indicate that the product should not be kept over twenty-four hours, and if kept, refrigeration should be used to retard the growth of the bacteria.

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