DEFECTS IN THE QUALITY OF BUTTER

BY

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FOREWORD.

PRODUCERS AND MANUFACTURERS of inferior-quality dairy products annually receive several million dollars less than they would if they did not permit imperfect conditions and methods in the production, manufacture, and marketing of dairy products.

In the larger wholesale markets the price of butter depends primarily upon its quality and condition as determined by the receiver or by local or Federal butter inspectors on close examination of the flavor, body, color, salt, and package. During the year 1920 the marginal difference in the prices of high and lower quality butter amounted at times to as much as 15 cents between 87 score and 92 score. In fact, there has never been a time in the history of American butter making when it paid so well to produce high-quality butter as during recent years.

As a business proposition it is safe to assume that quality is a chief factor in determination of butter prices, and a butter-making plant that wishes to pay the highest market price for butterfat and expects to build up a regular, satisfactory, and permanent market must eliminate the defects which result in low quality and low prices.

In the marketing of butter in a wholesale market it is rather surprising how a small defect in quality will result in the loss of a sale or a cut in the price. Often the lack of proper attention or care in the creamery in grading the cream, or in churning, working, salting, or packing the butter, results in varying defects and qualities and an unstandardized product. Uniformity in quality, or standardization of quality, is of great importance. It behooves the butter maker or creamery manager who wishes to insure an active demand for his product at all times to ascertain the particular requirements of the market he is supplying and to strive to eliminate every defect in the quality of butter that is discriminated against by the trade. High quality and uniformity of product, with good marketing methods, are required to secure the largest net return and the highest degree of satisfaction.
DEFECTS IN THE QUALITY OF BUTTER.¹

By C. W. FRYHOFER, Butter Inspector, Food Products Inspection Service, Bureau of Agricultural Economics.

CONTENTS.

<table>
<thead>
<tr>
<th>Page</th>
<th>Five classes of defects in quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Defects in body and texture—Con.</td>
</tr>
<tr>
<td>2</td>
<td>Causes of defects in body texture</td>
</tr>
<tr>
<td>3</td>
<td>Defects in color</td>
</tr>
<tr>
<td>4</td>
<td>Prevention of color defects</td>
</tr>
<tr>
<td>5</td>
<td>Defects caused by salt</td>
</tr>
<tr>
<td>6</td>
<td>Prevention of gritty butter</td>
</tr>
<tr>
<td>7</td>
<td>Prevention of mold</td>
</tr>
<tr>
<td>8</td>
<td>Location of butter inspection offices</td>
</tr>
</tbody>
</table>

FIVE CLASSES OF DEFECTS IN QUALITY.

In the market inspection of butter its quality is considered from the standpoint of flavor, body, color, salt, and package. In determining the final score each of these factors is rated separately, with the following number of points given to each: Flavor, 45; body, 25; color, 15; salt, 10; and package, 5; total, 100. The ratings given to each factor are governed by the absence or presence of certain defects. A careful reading of the following rules used by the Federal Bureau of Agricultural Economics in the inspection of butter under the food products inspection law will indicate the effect of defects on the rating given each factor and the final score of the butter.

THE RATING OF FLAVOR.

The rating given to flavor shall be determined by the flavor characteristics as follows:

A. Desirable flavors, minimum rating of 37 points.

(a) Butter that is fresh, fine, sweet, mild and clean in flavor and has a certain creaminess or richness that gives it a particularly pleasing taste and aroma, shall receive a rating of 40 to 45 points inclusive.

¹The material contained in this circular was contributed in part by S. C. Thompson and M. P. A. Søndergaard of the Dairy Division of the Bureau of Animal Industry.
²Those desiring detailed information regarding butter inspection may obtain a copy of Service and Regulatory Announcement (Markets) No. 51, The Inspection of Butter Under the Food Products Inspection Law, by applying to the Division of Publications, U. S. Department of Agriculture, Washington, D. C.

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A. Desirable flavors, minimum rating of 37 points—Continued.

(b) Butter that is fresh, fine, sweet, and clean in flavor if of fresh make, or fine, sweet, and clean if storage, shall be given a rating of 38 to 39 points, inclusive.

c) Butter that is fresh, sweet, and clean in flavor if of fresh make, or sweet and clean if storage, shall be given a rating of not less than 37 points.

B. Objectionable flavors.

(a) Maximum rating of 36 points. Butter that is free from "foreign" or "off" flavors but which shows any of the following taints or flavors shall receive a rating of 36 points or less for flavor, according to the degree of defect, and shall receive a maximum of 36 points, provided the flavor is only slightly objectionable.

(1) Mechanical taints—flavors having their origin in the process of manufacture or in the conditions under which the butter is held after manufacture, but not indicating aged or stale cream: Burnt, oily, heated, mealy, frozen cream, greasy, lardy; also storage and fruity flavors in held butter.

(2) Bacterial taints—flavors having their origin in bacterial development but not indicating aged or stale cream: Cowy, barny, acidy, yeasty, summery, cheesy, curdy.

(3) Feed taints—flavors having their origin in feed conditions at the point of production, but not indicating aged or stale cream: Weedy, frosted feed.

(b) Maximum rating of 35 points. Butter showing the following objectionable flavors shall be given a rating of 35 points or less, according to the degree of defect: Metallic, wintry, bitter; also "old" flavor in held butter.

c) Maximum rating of 33 points. Butter showing the following objectionable flavors shall be given a rating of 33 points or less: Unclean, musty, distinct lime or alkaline flavors.

C. Foreign flavors.

(a) Maximum rating of 33 points. Butter showing a taint of gasoline and having no other objectionable flavor shall be given a rating of 33 points or less.

(b) Maximum rating of 32 points. Butter showing garlic or wild onion flavor shall be given a rating of 32 points or less.

D. Off flavors, maximum rating of 32 points. Butter that shows any of the following flavors ordinarily termed "off" flavors, shall be given a rating of 32 points or less, depending upon the extent of the defect: Fishy, tallowy, unclean, stale cream, stale oily, stale metallic, stale sour, stale cheesy.

THE RATING OF BODY.

Butter receiving the maximum rating of 25 points for body must have a firm, waxy texture and a perfect grain, as indicated by a jagged or irregular toothed edge, when the butter is broken apart. It must be free from salviness or excess free moisture and must not show a milky brine.

THE RATING OF COLOR.

Butter receiving the full rating of 15 points for color must be free from all foreign color specks, waviness, streaks or mottles, and
must be uniform in color in all parts. The ratings given to the
various degrees of uniform color shall be as follows:
A. Light color: Butter having a light straw color shall be given the full rat-
ing of 15 points.
B. Medium color: Butter having the color of the natural grass product, with-
out the use of additional coloring, shall be given the full rating of 15
points.
C. High color: Butter having a color higher than that of natural grass butter
shall be given a maximum rating of 14 points.

**THE RATING OF SALT.**

Butter which is not excessively high in salt and which shows no
undissolved salt and in which the salt is uniform shall be given the
maximum of 10 points for salt. The ratings given butter showing
different amounts of salt properly dissolved shall be as follows:
A. Unsalted butter shall be given the full rating of 10 points.
B. Light salted butter that contains 1\(\frac{1}{2}\) per cent or less of salt and has a very
slight salty taste shall be given the full rating of 10 points.
C. Medium salted butter that contains over 1\(\frac{1}{2}\) per cent and not above 3\(\frac{1}{2}\) per
cent of salt and has a mild and yet distinct salty taste shall be given
the full rating of 10 points.
D. High salted butter that contains over 3\(\frac{1}{2}\) per cent of salt and has a sharp,
briny, or pronounced salty taste shall be given a maximum rating of 9
points.

**THE RATING OF PACKAGE.**

Butter receiving the full rating of 5 points for package must be
neatly and properly packed in sound, uniform packages which are
clean and entirely free from mold.

**Chart of characteristics of butter of certain scores or qualities.**

<table>
<thead>
<tr>
<th>Defined score</th>
<th>Flavor</th>
<th>Body</th>
<th>Color</th>
<th>Salt</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 and above</td>
<td>Desirable flavors: Fine, sweet, clean, with pleasing creamy aroma.</td>
<td>Perfect, firm, waxy.</td>
<td>Perfect light or medium.</td>
<td>Perfect light or medium.</td>
<td>Must be attractive, neat, clean, uniform and sound.</td>
</tr>
<tr>
<td>94-93</td>
<td>Desirable flavors: Fine, sweet, clean. Total defects other than flavor not over (\frac{1}{2}) point.</td>
<td>Firm.............</td>
<td>Light or medium.</td>
<td>Light or medium.</td>
<td>Free from mold, clean, uniform, and sound.</td>
</tr>
<tr>
<td>92....</td>
<td>Desirable flavors: Sweet and clean (slight storage flavor in held butter). Total defects other than flavor not over (\frac{1}{2}) point.</td>
<td>...do............</td>
<td>Light or medium, slight, curd specks or waviness.</td>
<td>Light or medium, well dissolved, uniform.</td>
<td>Clean, uniform, and sound.</td>
</tr>
<tr>
<td>91....</td>
<td>Slight objectionable flavors, fairly sweet and fairly clean (storage flavor in held butter).</td>
<td>...do............</td>
<td>Light or medium, uniform, curd specks, waviness.</td>
<td>Light, medium, or high, well dissolved, uniform.</td>
<td>Do,</td>
</tr>
</tbody>
</table>
### Chart of characteristics of butter of certain scores or quantities—Continued.

<table>
<thead>
<tr>
<th>Defined score</th>
<th>Flavor</th>
<th>Body</th>
<th>Color</th>
<th>Salt</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>Objectionable flavors shown: Fairly sweet and fairly clean, may be flat and lacking in flavor (old flavor in held butter).</td>
<td>Fairly firm</td>
<td>Light or medium, fairly uniform, wavy.</td>
<td>Slightly gritty, fairly uniform.</td>
<td>Clean, uniform, and sound.</td>
</tr>
<tr>
<td>89</td>
<td>Objectionable flavors permitted; reasonably sweet and reasonably clean.</td>
<td>Reasonably firm.</td>
<td>Light, medium, or high, distinct waviness.</td>
<td>Slightly mottled.</td>
<td>Uniform and sound.</td>
</tr>
<tr>
<td>88</td>
<td>Objectionable flavors distinctly developed, also unclean taint, musty, distinct lime or other alkaline flavors shown.</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Do.</td>
</tr>
<tr>
<td>87</td>
<td>Garlic and off-flavors slightly evident.</td>
<td>Weak and considerably defective.</td>
<td>Distinctly mottled or streaked.</td>
<td>Gritty and irregular.</td>
<td>Do.</td>
</tr>
<tr>
<td>86</td>
<td>Garlic and off-flavors distinctly evident.</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Do.</td>
</tr>
<tr>
<td>85</td>
<td>Pronounced garlic and off-flavors.</td>
<td>Weak, but must be fairly solid boring.</td>
<td>May be ragged boring.</td>
<td>Very mottled, streaked, or extremely high.</td>
<td>Extremely high irregular and gritty.</td>
</tr>
<tr>
<td>84-83</td>
<td>May be slightly ranched or strong on tops and sides.</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Do...</td>
</tr>
<tr>
<td>82-30</td>
<td>Ranched or strong on tops and sides.</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Do...</td>
</tr>
<tr>
<td>80-75</td>
<td>Butter containing defects of a more marked degree than specified above are given a score below 80, depending upon the extent of the defects.</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Do...</td>
</tr>
</tbody>
</table>

## DEFECTS IN FLAVOR.

A classification of the various defects in flavor and the rating given these defects by the Bureau of Agricultural Economics in the inspection rules under the food products inspection law was given on page 1 under the heading “The rating of flavor.” It should be noted that butter to score 37 on flavor or grade 92 or “extra,” as it is now known in the trade, must be “fresh, sweet, and clean in flavor if of fresh make, or sweet and clean if storage.” To receive a rating of above 37 on flavor or score above 92, the flavor must be more desirable, creamy, sweet, and fine and of particularly pleasing taste and aroma. It is obvious that such flavors in butter can be supplied only by cream that possesses them. Therefore any cream containing objectionable flavors should be graded out if high-scoring butter is to be made. The importance of proper grading and of offering an inducement to producers to produce cream of the highest quality must not be overlooked by the creamery manager or butter maker who desires to produce high-quality butter.
Objectionable flavors in butter that show only slight development may include mechanical taints which have their origin in defective processes of manufacture, bacterial taints which indicate slight bacterial development of undesirable character, and feed taints caused by feed conditions. Butter possessing these, but showing neither aged nor stale cream flavor, is rated 36 or less on flavor, depending on their development, and scores 91 or less, and ordinarily sells for 1 cent to 3 cents less per pound than butter scoring 92. As the degree of defect increases or more objectionable flavors become prominent, such as slight metallic, bitter, musty, unclean, stale sour, stale oily, tallowy, cheesy, or fishy, the rating of flavor is cut and a lower score results, with a corresponding reduction in value of the butter. The causes of some of these objectionable flavors are suggested in their names, while others have been determined by thorough investigations. Among these latter may be mentioned fishy, metallic, and oily flavors.

**FISHY FLAVOR.**

Extensive investigations of fishy flavor in butter have not yet revealed any specific factor which might be considered as the sole cause of this objectionable taste. Theories advanced from time to time have attributed it to such causes as impure natural ice added direct to cream; overripe or otherwise defective starters; improper pasteurizing; exposure of milk and cream to the hot sun during transit; vats, starter cans, and pasteurizing apparatus with the tin worn off, rusty pipes, cans, and utensils; slushy texture in butter, and decomposition of the nonfatty constituents caused by bacterial action.

However, since investigations in different countries have met with seemingly different results, it is assumed that the cause is complex in nature and that fishy flavor has its origin in various factors or a combination of factors. One thing commonly agreed upon is that acid in cream is essential to the development of fishy flavor. This has also been demonstrated in the butter made from pasteurized sweet cream for the use of the United States Navy and which, when kept for long periods of time in cold storage, has never developed fishy flavor.

Inasmuch as it has been demonstrated that iron rust and verdigris when mixed with high-acid cream cause fishy flavor, it is generally believed that these ingredients are frequently contributing factors and that in most cases the trouble may be traced to chemical changes.

**PREVENTION OF FISHY FLAVOR.**

Among the various preventive methods, the following are worthy of careful consideration:
1. As fishy flavor occurs most readily in high-acid cream, it is obvious that the control of acidity in the ripening process is of utmost importance. Cases are on record in which the trouble has been entirely eliminated by close attention to the propagation of starters and to the checking of acidity in the cream at the proper time during the ripening process. Irregular and infrequent delivery of cream should be avoided. This detrimental, slipshod method causes the cream to be held for an undue length of time and usually results in the development of high acid.

2. Exposure to the hot sun during transit should be prevented by a suitable covering or blankets, preferably applied wet.

3. The use of rusty, insanitary, and otherwise defective cans should be prohibited. When cans are returned empty it is essential that they be properly washed, sterilized, and dried at the factory.

4. Great caution should be exercised when pasteurizing to prevent the "oiling off" of the fat during the process. If the flash method is used, it is essential that the supply of cream be constant and so regulated that the pasteurizer may work at full capacity. When the vat method is used it is important that the cream be stirred sufficiently while being heated. If the cream is of a heavy consistency, a slow heat must be applied until it flows readily over the coils. To insure proper stirring a vat should be filled only to within 4 inches of the top.

5. Since it has been proved that fishy flavor may develop from the action of acid on copper, iron, and certain alloys in pipes, pasteurizers, coolers, starter cans, vats, or other apparatus, none but heavily tinned apparatus should be used.

6. High churning temperatures and overworking of the butter should be guarded against.

**METALLIC FLAVOR.**

Metallic flavor, like fishy flavor, is one of the most objectionable tastes that develops in butter. The two are closely allied, and both apparently may originate from the same sources. In fact, metallic flavor is often considered to be a forerunner of fishy flavor.

Butter affected with metallic flavor is avoided by butter dealers because of its poor keeping qualities. Being unfit for storage purposes, such butter must be consumed immediately if heavy loss is to be avoided.

**PREVENTION OF METALLIC FLAVOR.**

While it is true that the specific element or combination of elements producing metallic flavor has not been fully determined, it has been amply demonstrated that the following precautions will prevent or greatly retard this defect.
Defects in the Quality of Butter.

1. There should be no cracks or open seams in vats, coils, or any other apparatus with which cream comes in contact. Small defects or leaks of this sort often result in serious contamination of the cream.

2. Cans, utensils, faucets, boltheads in churn, etc., should be kept free from rust by scouring or retinning. The presence of apparently insignificant traces of iron rust and verdigris from exposed copper has frequently proved to be the direct cause of the metallic flavor in butter. This is especially the case if heated cream containing a certain amount of acid comes in contact with exposed surfaces.

3. Abnormal fermentation should be watched for in starter and cream. As soon as a slight “off” or “foreign” flavor becomes noticeable, a new culture should be provided.

4. So far as possible, dilution of cream with water should be avoided. Pasteurization of diluted cream whose viscosity has been reduced tends to injure the butter fat.

5. High acidity in cream should be guarded against. Acidity of cream has proved to be a fundamental factor in producing metallic flavor.

6. Butter should not be overworked. Overworking tends to increase the air content, and the presence of an abnormal amount of air causes rapid oxidation of the casein, thus tending to produce metallic flavor.

OILY FLAVOR.

Oily flavor in butter is a defect most frequently found during the summer months. It includes a variety of flavors all distinctive to the taste. While these flavors are generally associated with butter made from excessively sour and poor material, they are by no means confined to the lower grades. Even butter made from sweet cream is often found to have a marked oily flavor. Whenever such flavors are present, the butter is considered by all dealers to be lacking in keeping qualities.

These oily flavors may be divided into two groups: The unclean, fatty, and greasy kind, and the more pronounced strongly-repugnant kind, similar to the taste of old, impure machine oil. The first kind is caused by faulty manufacturing methods. The second is attributed by investigators to undesirable bacterial action.

PREVENTION OF OILY FLAVORS.

While it is difficult to give specific preventives or remedies for all cases of oiliness, the following precautions have proved helpful in many instances:

1. Close attention to the quality of the cream received will impress patrons with the necessity of the proper handling of cream on
the farm and during transit where the cans are likely to be exposed to the sun.

2. During pasteurization of cream great care must be exercised to prevent entirely the "oiling off" of the butter fat, which is likely to occur through the underfeeding of the pasteurizer when the continuous method is used, through insufficient stirring of cream in the vat method, or through the sudden application of too much heat.

3. The dilution of cream with water, either through leaky coils or vats, or by rinsing cans with excessive amounts of water, will almost invariably result in an oily product.

4. Oiliness has sometimes been traced to impure wash water or to water containing too much iron.

5. Too much stress can not be placed upon the necessity of insuring the proper condition of the butter for working. This condition can be obtained only by cooling and holding the cream at a sufficiently low temperature to obtain the desired hardening of the fat before churning.

6. Overworking of butter, especially when in a soft condition, breaks down the grain and develops oily flavor.

7. Of great significance in successful buttermaking is the careful and accurate preparation of starters. A weak or contaminated starter is often responsible for oiliness in butter.

DEFECTS IN BODY AND TEXTURE.

The body of butter is almost entirely under the control of the butter maker, and defective body can generally be charged to his failure to conduct properly the various processes of manufacture. The condition of the cream when received, however, sometimes makes his task a difficult one. In the case of cream which has been badly overheated, or which comes from stripper cows fed on dry feed in cold weather, it is practically impossible to produce perfect body. While the butter maker is responsible for most of the body defects, yet difference in localities, change of season, and varying temperatures are factors which he must always take into consideration. He must understand the conditions and have proper equipment in his factory for controlling them. The body of butter has a marked effect on the flavor, as all defects in body injure the flavor to a greater or lesser degree.

In judging the body and texture of butter, a perfect body must be firm, with a grain which has a rough, irregular edge when broken, and a waxy texture. The most common defects are greasy body, salvy body, weak body, leaky body, and mealy body.
Defects in the Quality of Butter.

CAUSES OF DEFECTS IN BODY AND TEXTURE.

A greasy body is usually due to one or more of the following causes: Churning cream which has not been properly cooled, churning at too high temperature, churning very rich cream, washing with water that is too warm, overworking the butter, and allowing it to stand at too high temperatures before placing it in the refrigerator. In greasy butter the grain has been destroyed. This is largely due to high temperatures, which may have been during the manufacturing process, or the fat in the cream may have overheated and not properly cooled prior to churning. Overworking soft butter also has much to do with making it greasy.

A salvy body is similar to greasy body to the extent that the grain is broken down, but in the case of salvy body it is caused by improper working or by overworking while the butter is in a firm condition. Therefore butter with salvy body is sticky or pasty. The extreme chilling of butter granules in the churn just before working often causes this defect.

A weak body lacks firmness and compactness and melts down quickly when exposed to moderately high temperatures. It is usually the result of churning cream which has not been sufficiently cooled. Either it was not cooled to a low enough temperature or it was not held long enough at a low temperature. Overworking butter made from cream not properly cooled tends to cause weak body. Weak-bodied butter is often leaky.

A leaky body is caused by incomplete and improper combining of the fat and water which leaves the water in pockets or in large drops that easily leak from the butter. The cause is similar to that of other body defects, namely, churning cream which has not been properly cooled, in which the fat globules have not been sufficiently hardened, together with improper methods of salting and working the butter. Extremely low churning temperature and the use of very cold wash water with insufficient working also cause leaky butter. If the body of the butter is firm and the salt and water properly incorporated, so that the brine is distributed in fine droplets throughout the entire mass of butter, leakiness will not appear. Leaky butter often contains less actual moisture than properly worked butter, although it appears to show an excess of water.

A mealy body has a granular or mealy consistency which is especially noticeable when placed in the mouth. It does not have the smooth, waxy texture of properly made butter.

Mealiness is caused by heating the cream too rapidly or too high without sufficient agitation or by partly churning the cream through excessive agitation during the cooling process when the vat method of pasteurization is used. It may also be caused by underfeeding the pasteurizer when the continuous method is used.
When cream is heated too rapidly or too high without sufficient agitation, or when the continuous pasteurizer is not fed rapidly enough, the fat melts and separates. When this melted fat hardens on cooling it becomes granular and gives the butter a granular or mealy consistency.

To prevent mealiness the cream should be so handled that at no time will it be exposed to excessive temperatures during pasteurization. It should be kept thoroughly agitated from the time heating begins until cooled to a temperature of 70° F. or below. If the continuous method of pasteurization is used the cream should flow through the machine with sufficient rapidity so that it will not be exposed too long to the high temperature used.

Another cause of mealiness is the improper treatment of frozen cream. If the attempt is made to thaw such cream rapidly by exposure to a very high temperature the fat will almost invariably be melted, and this will cause mealiness when the fat is cooled. This can be prevented by taking care not to heat above 90° F. It is best done by setting the cans of cream in a tank of water kept at that temperature.

All body defects may be avoided by cooling the cream to churning temperature or below, holding at that temperature for 3 or 4 hours, at least, and preferably overnight, churning at temperatures which will produce butter granules the size of wheat kernels in from 45 to 50 minutes, washing the butter with water of the same temperature as the buttermilk, or 1 to 2° colder in summer and a similar amount higher in winter, working immediately just enough to incorporate thoroughly the salt and water, producing a firm, waxy body, and placing it at once in the refrigerator. To get the most satisfactory and uniform results, cream having a fat content of from 27 to 33 per cent should be used. It is also desirable, whatever the fat content of the cream, that it be uniform from day to day to prevent varying results.

DEFECTS IN COLOR.

Defects in color always lower the market value of butter, whether the quality is good or poor. However, the higher the quality the more serious becomes the defect and the more it injures the market value of the butter, for the reason that the class of trade using the fine-quality butter is as discriminating in regard to color as it is to flavor or quality.

Mottles are innumerable small spots of different shades of yellow color, irregular in shape, and appearing throughout the entire mass. Wavy butter shows different shades of yellow color in the form of layers or waves, and streaked butter shows different shades of yellow color in the form of streaks or blotches.
Defects in the Quality of Butter.

This unevenness in color is mainly caused by the water and salt being distributed unevenly in the butter, although in the case of streakiness and waviness, incorrect setting of the churn and defective working rollers may be contributing causes. When water and salt are not evenly distributed in butter, that portion which has the brine more completely incorporated or broken up into finer particles will show a lighter shade of yellow than other portions in which the incorporation is less complete. Therefore, insufficient or irregular working results in uneven color. Continued working breaks up the particles of brine still further and causes a paler color, which explains the different shades found in butter of different churnings, even when no artificial color is used. Overworked butter, however, always has a dull, unattractive, and pale appearance.

Prevention of Color Defects.

The main preventive measures lie in working the butter uniformly and sufficiently to insure a thorough dissolving of the salt and a uniform incorporation of the moisture without injuring the body. This can be accomplished only by maintaining the proper temperature of the butter throughout the working period.

To insure uniform working it is necessary that the working rollers be straight, in perfect condition, and an equal distance apart at both ends and in the middle, and that the churn be set practically level. If the churn is not level the butter has a tendency to slide gradually toward the lower end, there to rub constantly against the end of the churn while being worked. Streaked butter is the result. Uneven color may result also from overloading the churn during the working process, or from the rollers being farther apart at one end than the other. Worn, defective, or improperly set rollers are likely to result in some portions of the butter receiving more working than others. When such butter is packed, wavy color naturally appears.

If at the time the salt is added the moisture content of the butter is low, the method of sprinkling the salt uniformly over the entire batch is to be preferred to the trench method, as a more complete incorporation is obtained.

White specks in butter arise from curd formation in the cream. When thin cream is held at a comparatively high temperature, the skim milk has a tendency to settle and coagulate, forming a curd which breaks up into fine, hard particles during churning. These curd specks become mixed with the butter and not only produce white specks but greatly reduce the keeping qualities. Skimming a rich cream or holding it at low temperatures and stirring it frequently will prevent the formation of hard curd. Curd particles may be partially eliminated by carefully straining the cream into
the churn and by washing the butter thoroughly while in the granular state. Hard curd particles are sometimes formed in the pasteurization of thin mixed sweet and sour cream. Such cream should be held at a temperature of about 110° F. for half an hour before being heated to pasteurization temperature.

Yellow specks are caused by sediment in the color which, when mixed with butter, appears as red or yellow blotches. Such sediment is formed when the coloring matter becomes cold, especially if exposed to freezing temperatures. Butter color that shows sediment should be discarded, as a rule, although it may sometimes be restored by placing the container in boiling water for an hour or more.

**DEFECTS CAUSED BY SALT.**

Grittiness in butter is due to the presence of undissolved salt, and is objectionable because it gives the butter a coarse, salty flavor, while high-grade butter has a mild, delicate flavor and smooth texture.

The principal causes of grittiness are the use of too much salt and insufficient working. Other causes are the use of salt that is too hard or too cold, and adding the salt to butter that is too dry. If salt is dry and hard it will not dissolve quickly, and when the working process is completed the butter still contains grains of salt. A similar condition may result from the addition of cold salt to the butter granules, the cold retarding the process of dissolving. If salt is hard and cold it may be moistened with warm water which will soften and warm it so that the dissolving will be hastened. The quantity of salt that can be dissolved in butter depends on the water content of the butter, and if the granules are drained excessively there may not be water enough to dissolve the quantity of salt desired. Even though the butter contains the full amount of water permitted by law, it may be insufficient to dissolve the salt if excessive quantities of the latter are used.

**PREVENTION OF GRAINY BUTTER.**

If the proper amount of salt is added and the butter is in normal condition, the butter should be worked until the salt is completely dissolved. If the body of the butter is too firm, more working will be required to distribute and dissolve the salt properly. Grittiness and irregular color may be overcome by proper working. The use of too coarse salt has a tendency to retard its solution and may result in grittiness if the butter is too dry or is worked incompletely or too rapidly.

**DEFECTS IN PACKAGE.**

The higher the quality or score of the butter, the more exacting are the requirements in regard to appearance, style, and proper finish
The butter. Moisture, of the finest quality demands that the attractiveness of the package be in keeping with the high quality of the product. An attractive package has a psychological effect on the customer which should not be overlooked, even though the quality of the product is not the best.

**DEFECTS THROUGH MOLD.**

Mold is a condition that may be present on the outer or inner surface of the container, the parchment liner or wrapper, or the butter. The source of the mold may be mold spores in the cream, on the apparatus and utensils with which the butter comes in contact, on the parchment liners, or packages, or in the refrigerator. Air, moisture, food materials, and moderate temperatures are the main factors which promote mold development. It may appear at any season of the year, but warm, damp weather conditions are especially favorable for its growth, and consequently it is most common during the spring and early summer.

**PREVENTION OF MOLD.**

Scientific studies have shown that mold may be prevented by the application of heat, the use of simple remedies, and the observance of general rules of sanitation. As the germination of mold spores requires a certain amount of moisture, all buttermaking establishments should be equipped with a good system of ventilation, especially in the storage room where packages and liners are kept.

To prevent the development of mold the cream must be properly pasteurized and all apparatus and utensils thoroughly sterilized immediately before using. Casein furnishes an excellent food for mold, therefore butter containing excessive quantities of buttermilk or coagulated curd is susceptible to mold growth. Thorough washing of the butter tends to reduce excessive quantities of casein in it. The tubs or boxes should be submerged in water at 180° F. for a few minutes, steamed over a steam jet, and paraffined. Paraffin forms a surface on which mold can not grow. It closes up pores and cracks in the wood, thus making the containers practically air-tight. It prevents the forming of an air space between the butter and the container, which is often found when the moisture leaks out or is absorbed by the wood. The paraffin should be applied in a thin coating at a temperature of not less than 240° F. This can be done best with a paraffining machine. The covers should receive the same treatment as the box or tub.

The liners should be soaked in a scalding brine solution for a few moments preceding their use. This brine solution should be fre-
quenty changed because of the chemical and sizing substances thrown off from time to time by the parchment paper.

Since air is necessary for the growth of mold, butter should be solidly packed, so as to leave no air pockets.

Mold develops most readily between the temperatures of 50° F. and 65° F. It is essential, therefore, that the temperature of the refrigerator be held below the minimum stated. The refrigerator, of course, should be kept dry and free from all mold spots. After these precautions have been taken, care must be exercised that contamination does not occur later and that the butter is constantly kept under conditions unfavorable to the growth of mold spores.

**LOCATION OF BUTTER INSPECTION OFFICES.**

The Bureau of Agricultural Economics of the United States Department of Agriculture maintains a butter-inspection service on the Boston, Chicago, New York, Philadelphia, and San Francisco markets, and at the request of shippers or other financially-interested parties makes official inspections of butter offered for interstate shipment or received at important central markets designated by the Secretary of Agriculture. These inspections are made in accordance with rules and regulations prescribed by the Secretary of Agriculture, and the fees charged depend on the size of the lot or the number of churnings in it. Any buttermaker, shipper, or dealer may obtain a report on the quality and condition of butter shipped to these markets by requesting the Bureau of Agricultural Economics to make an inspection. The addresses of the officers in these cities are as follows: 402 Atlantic Avenue, Boston, Mass.; 505 City Hall Square Building, Chicago, Ill.; 204 Franklin Street, New York, N. Y.; 312 The Bourse, Philadelphia, Pa.; Appraisers' Building, San Francisco, Calif.; United States Department of Agriculture, Washington, D. C.