

Effect of acidity and salt content on the keeping quality of butter

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1. Introduction

Developed acidity is one of the important factors in the appearance of by-flavours in butter during cold storage. The keeping quality of washed butter showed significant improvement with increasing serum alkalinity after 6 months storage (14). The butter made from cream ripened to 25°SH had the best organoleptic properties and the best keeping quality (4). Salted butter made from sweet cream kept somewhat less well than unsalted ripened cream butter of high plasma acidity, both types were significantly inferior to sweet-cream butter and to ripened-cream butter of low plasma acidity (9).

The effect of acidity is intensified by the addition of salt. Salted butter showed little deterioration during cold storage at -12°C. The tendency of butter to become oily increased with increasing salt content, this becoming more pronounced when the butter was stored for long periods. (13)

The salting of butter at a level of 1.5% had an adverse effect on its organoleptic quality during storage particularly at 18°C. for 48 days. (6)

The object of this work was to find the maximum limit of acidity in unsalted and salted butters at which limit the by-flavour defect could be observed.

Materials and methods:

Precautions were taken during processing to avoid contamination with trace elements. The use of metal equipments and containers was kept at minimum level and only equipment made from stainless steel was used. Fresh buffalo milk obtained from the herd of the Faculty Agriculture at Kafr El Sheikh was separated and the resultant sweet cream (35% fat) was churned. In the manufacture of acid butters, the acidity of the cream was adjusted by adding 1 N lactic acid solution.

Direct acidification with lactic acid was used in preference to ripening with starter to control the final acidity with greater accuracy. Five kilogram portions of cream were churned in a glass churn. 1% salt was added to the butter at the granule stage. The butter was divided into twelve samples, 100 g each, wrapped and stored at 5°C. Every second week a sample was withdrawn, up to 6 months, for examination. Unsalted and salted butters were prepared from creams with acidity of 0.150%, 0.25% and 0.35% lactic acid respectively. Six replicates were made from each.

The moisture, curd, salt and fat contents of butter were determined as given by Ling (7).

Table 1

Effect of salt on the keeping quality of butter from sweet cream (acidity 0.15%)
(Average results of 6 replicates)

| Storage period at 5 °C (days) | Unsalted | | | | Salted | | | |
|-------------------------------|-------------|--------------|---------|----------------------|-------------|--------------|---------|--------------------|
| | Acid degree | P. V. of fat | Grading | | Acid degree | P. V. of fat | Grading | |
| | | | Score | Criticism | | | Score | Criticism |
| 0 | 0.1 | 0.00 | 94.0 | ..... | 0.2 | 0.00 | 94.0 | ..... |
| 15 | 0.7 | 0.00 | 94.0 | ..... | 1.0 | 0.00 | 94.0 | ..... |
| 30 | 0.9 | 0.00 | 94.0 | ..... | 1.2 | 0.05 | 94.0 | ..... |
| 45 | 1.5 | 0.00 | 94.0 | ..... | 1.6 | 0.10 | 93.5 | ..... |
| 60 | 2.1 | 0.05 | 93.5 | ..... | 2.3 | 0.10 | 93.0 | ..... |
| 75 | 2.7 | 0.07 | 93.0 | ..... | 2.9 | 0.10 | 92.5 | ..... |
| 90 | 3.4 | 0.07 | 92.5 | ..... | 4.0 | 0.10 | 92.0 | ..... |
| 105 | 4.0 | 0.09 | 92.0 | ..... | 5.2 | 0.15 | 91.0 | sl. stale |
| 120 | 5.1 | 0.10 | 91.5 | sl. stale | 7.1 | 0.20 | 89.0 | sl. acid, sl. oily |
| 135 | 7.0 | 0.15 | 90.0 | sl. bitter, sl. acid | 8.4 | 0.22 | 88.0 | objectionable |
| 150 | 8.2 | 0.20 | 89.0 | acid. sl. oily | 9.0 | 0.24 | 85.5 | objectionable |
| 165 | 8.8 | 0.20 | 88.0 | objectionable | | | | |
| 180 | 9.5 | 0.22 | 86.0 | objectionable | | | | |

P. V. = peroxide value, sl. = slightly.

Table 2

Effect of salt on the keeping quality of butter made from cream moderate acidity (0.25%)
(Average results of 6 replicates)

| Storage period at 5°C (days) | Unsalted | | | | Salted | | | |
|------------------------------|-------------|--------------|---------|------------------|-------------|--------------|---------|----------------|
| | Acid degree | P. V. of fat | Grading | | Acid degree | P. V. of fat | Grading | |
| | | | Score | Criticism | | | Score | Criticism |
| 0 | 0.2 | 0.00 | 93.5 | ..... | 0.3 | 0.00 | 93.5 | ..... |
| 15 | 1.0 | 0.00 | 93.5 | ..... | 1.4 | 0.00 | 93.0 | ..... |
| 30 | 1.4 | 0.00 | 93.5 | ..... | 1.9 | 0.00 | 93.0 | ..... |
| 45 | 2.0 | 0.00 | 93.0 | ..... | 3.2 | 0.05 | 92.5 | ..... |
| 60 | 3.0 | 0.05 | 93.0 | ..... | 4.7 | 0.09 | 92.0 | ..... |
| 75 | 4.5 | 0.08 | 92.0 | ..... | 6.5 | 0.12 | 91.0 | sl. acid. |
| 90 | 6.7 | 0.10 | 91.0 | sl. acid. | 8.0 | 0.17 | 90.0 | acid. |
| 105 | 8.0 | 0.14 | 90.0 | sl. bitter, acid | 9.0 | 0.20 | 89.0 | acid, sl. oily |
| 120 | 9.9 | 0.19 | 89.0 | acid, sl. oily | 11.0 | 0.22 | 88.0 | objectionable |
| 135 | 10.6 | 0.22 | 88.0 | objectionable | 12.5 | 0.28 | 86.0 | objectionable |
| 150 | 11.4 | 0.25 | 87.0 | objectionable | | | | |

P. V. = peroxide value, sl. = slightly.

The unsalted butter from low acid cream had moisture, fat and curd contents of 13.05, 85.55 and 1.40%, respectively, while that from medium acid cream, were 13.9, 84.6 and 1.5%, respectively and that from high acid cream were 15.3, 82.8 and 1.70% in the same order.

Salted butter from low acid cream (0.15%) had a moisture content of 13.4%, a fat content of 84.3%, and a curd content of 2.3%. The corresponding averages for butter from moderately acid cream were 14.6, 82.8 and 2.6%, respectively, while those from high acidity cream were 15.8, 81.5 and 2.7%, respectively.

The acid degree of butter was determined according to the B. S (1952).

Peroxide value was determined on butter fat from fresh and stored butters as given by *Jacobs* (3).

Butter was organoleptically judged by a regular score panel of 5 persons according to *Nelson* and *Trout* (12). If the sample was graded objectionable, the storage was not continued.

Results

The effect of salt:

The effects of salt on the keeping quality of butters from sweet cream, cream of moderate and high acidity are shown in the Tables 1, 2, and 3 respectively.

Acidity of butter:

Fresh unsalted butter gave an average acid degree of 0.1 which gradually increased to a value of 3.4 after 90 days and 9.5 after 180 days storage.

The acidity of salted sweet cream butter followed the same trend but with somewhat higher figures.

The fresh unsalted butter from cream of medium acidity gave an average acid degree of 0.2, while the salted form that of 0.3.

The butters of both sources have shown a gradually increasing acid degree to 10.6 and 12.5 respectively, after 135 days storage.

The acidity of unsalted and salted butter from cream of high acidity followed the same trend but with somewhat higher figures, showing after 90 days 11.0 and 17.8 values, respectively.

Peroxide value:

The fresh samples of the unsalted butter from sweet cream, from cream of moderate and high acidity had peroxide value (P. V.) of zero and remained unchanged up to 45, 45 and 30 days of storage, respectively. The P. V. gradually increased in the case of the first type of butter after 180 days to 0.22, in the second type after 150 days to 0.25 and in the third type after 120 days to 0.26.

All types of salted butter showed lower oxidative stability than the unsalted ones during storage. The P. V. increased gradually to 0.20–0.21 after 120 days in the case of sweet cream butter, after 105 days in the case of butter made from cream of moderate acidity and in 60 days when the butter was made from a cream of high acidity.

Organoleptic properties:

The unsalted and salted butters made from sweet cream showed a clean, sweet, pleasant flavour up to 105 days storage. The loss in score points of the salted butter was only 0.5 after 90 days.

Table 3

Effect of salt on the keeping quality of butter made from cream of high acidity (0.35%)
(Average results of 6 replicates)

| Storage period at 5°C (days) | Unsalted | | | | Salted | | | |
|------------------------------|-------------|--------------|---------|----------------|-------------|--------------|---------|----------------|
| | Acid degree | P. V. of fat | Grading | | Acid degree | P. V. of fat | Grading | |
| | | | Score | Criticism | | | Score | Criticism |
| 0 | 0.3 | 0.00 | 93.0 | ..... | 0.4 | 0.00 | 93.0 | ..... |
| 15 | 2.4 | 0.00 | 93.0 | ..... | 3.0 | 0.09 | 92.5 | ..... |
| 30 | 3.8 | 0.00 | 92.5 | ..... | 6.4 | 0.15 | 92.0 | ..... |
| 45 | 5.0 | 0.05 | 92.0 | ..... | 9.0 | 0.17 | 90.0 | acid |
| 60 | 6.7 | 0.10 | 91.0 | sl. acid | 12.1 | 0.21 | 89.0 | acid, sl. oily |
| 75 | 8.8 | 0.15 | 90.0 | acid | 14.9 | 0.25 | 88.0 | objectionable |
| 90 | 11.0 | 0.20 | 89.0 | acid, sl. oily | 17.8 | 0.30 | 86.0 | objectionable |
| 105 | 13.2 | 0.22 | 88.0 | objectionable | | | | |
| 120 | 14.8 | 0.26 | 87.0 | objectionable | | | | |

P. V. = peroxide value, sl. = slightly.

Changes in the organoleptic properties of unsalted and salted butters made from cream of moderate acidity appeared somewhat lardier. In the case of unsalted sample a slight acid flavour was observed after 90 days, while the salted butter has shown a slight oily flavour after 105 days storage.

The changes of the organoleptic properties were more rapid in butter made from cream of high acidity. The unsalted butter had a clean pleasant flavour up to 45 days storage but the salted form has shown a slight oily flavour after 60 days storage in comparison to 90 days for unsalted butter.

The results indicated that in any case the keeping quality of unsalted butter was slightly superior to that of the salted one.

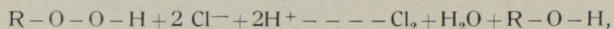
Discussion

The production of butter from cultured cream is a common practice due to the favourable flavour and properties of the resultant butter.

In the present study the composition of the butter made from cream of high acidity slightly differed from that of sweet cream; it was characterised by slightly higher moisture and curd contents and low fat content in comparison to butter from cream of low acidity. These results are in accordance with that reported by *Mulder* (11). The effect of acidity on the moisture content of butter was probably due to the difference in the viscosities of sweet and sour cream buttermilk and the retaining of protein particles from the acid buttermilk. Consequently granules from the sour cream do not drain as well as the granules from the sweet cream.

During storage, the keeping quality of butter was greatly affected by the acidity and salt content as judged by the organoleptic scoring, and peroxide value. Thus salted butters showed a lower keeping quality than unsalted ones, as unsalted butter manufactured from sweet cream or of cream of moderate acidity stands well without objectionable flavour up to 120–150 days at 5 °C in comparison to 105–120 days for corresponding salted butters. The present results are in accordance with that of *McDowell* (10) who reported that increasing salt content of butter up to 1.5% promoted lipid oxidation in the presence of copper contamination but not necessarily in its complete absence.

These results could be explained on the basis of the catalytic effect of salt on the oxidation of butterfat dispersed in acid salt solutions (8). These workers explained the acceleration of fat oxidation by added salt with the effect of chlorine which was formed by a reaction between fat hydroperoxides and hydrogen and chloride ions:



and which induced further oxidation of the fat.

The results also show that high acidity enhanced the development of by-flavour in butter; this is in accordance with the results given by *McDowell* (10) and *Koops* (5). This could be explained on the basis that at low pH values the interaction between cephalin from the fat globule membrane phospholipids and the copper containing membrane protein was enhanced (5). Since this phospholipid fraction is highly susceptible to oxygen the rate of oxidation of the lipid protein complex would increase considerably at low pH values.

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AZ ACIDITÁS ÉS A SÓTARTALOM HATÁSA A VAJ ELTARTHATÓSÁGÁRA

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Szerzők kísérletei szerint a vaj eltarthatósága a tejszín aciditásának növekedésével fokozatosan csökken. Édes tejszínből, ill. közepes és nagy aciditású tejszínből készült sózatlan vaj 5°C-on jól eltartható volt 135, ill. 105 és 75 napig. Sózott vajak eltarthatósága rosszabb volt amint a sózatlan vajaké. Édes tejszínből, ill. közepes és nagy aciditású tejszínből készült sózott vajak eltarthatósága 5°C-on való tárolásakor 105, ill. 90 és 45 nap volt.

ВЛИЯНИЕ КИСЛОТНОСТИ И СОДЕРЖАНИЯ СОЛИ НА СОХРАННОСТЬ СЛИВОЧНОГО МАСЛА

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На основании проведенных экспериментов установили, что сохранность сливочного масла постепенно уменьшается в результате повышения кислотности сливок. Не соленое сливочное масло полученное из сладких, средне-, и высоко кислотных сливок хорошо хранится при температуре 5°C в течении 135, 105 и 75 суток. Сохранность соленного сливочного масла была хуже несоленного. Сохранность соленного сливочного масла изготовленного из сладких, средне- и высоко кислотных сливок при температуре 5°C составляла 105, 90 и 45 суток.

EINFLUSS DER AZIDITÄT UND DES SALZGEHALTES AUF DIE LAGERFÄHIGKEIT VON GELAGERTER BUTTER

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Nach den Versuchsangaben vermindert sich die Lagerfähigkeit der Butter stufenweise mit der Erhöhung der Azidität der Sahne. Aus süsser Sahne bzw. aus Sahne von mittlerer und hoher Azidität hergestellte ungesalzte Butter war bei 5 °C 135 bzw. 105 und 75 Tage lang lagerfähig. Die Lagerfähigkeit von gesalzten Buttern war schlechter als die der ungesalzten Butter. Gesalzte Butter aus süsser Sahne bzw. aus Sahne von mittlerer und hoher Azidität war bei Lagerung bei 5 °C 105 bzw. 90 und 45 Tage lang lagerfähig.

EFFECT OF ACIDITY AND SALT CONTENT ON THE KEEPING QUALITY OF BUTTER

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According to the experimental results the keeping quality of butter gradually decreased with the increase of acidity of the cream. Unsalted butter manufactured from sweet cream and cream of moderate and high acidity, respectively, exhibited a keeping quality of 135, 105 and 75 days on storage at 5 °C. Salted butters showed lower keeping quality than unsalted butters. Salted butter manufactured from sweet cream and cream of moderate and high acidity, respectively, showed a keeping quality of 105, 90 and 45 days on storage at 5 °C.

L'INFLUENCE DE L'ACIDITÉ ET DE LA TENEUR EN SEL SUR LA STOCKABILITÉ DU BEURRE

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Selon les expériences des auteurs la stockabilité du beurre diminue avec l'augmentation de l'acidité de la crème. Les beurres non salés, produits à partir des crèmes douce, à acidité faible et forte se faisaient bien entreposer à 5°C pendant des périodes respectives de 135, 105 et 75 jours. La stockabilité des beurres salés était inférieure à celle des non salés. La stockabilité des beurres salés, fabriqués à partir de crèmes douce, d'acidité faible ou forte durait, à 5°C, 105, 95 et 45 jours.