RELATIONSHIP OF SALT CONTENT AND WEED TAINT PERCEPTION IN BUTTER

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SUMMARY

It was demonstrated in laboratory and commercial trials that the addition of salt to unsalted butter increased the organoleptic perception of inherent weed-tainting substances in butter.

When brine concentrations below 5.0 per cent. were obtained in unsalted butter which graded 93 and 92 pt. initially, insignificant changes in quality were evident. However, at levels of normal salting, i.e. a brine concentration of 9.60 per cent. representing a 1.52 per cent. salt content in a 15.80 per cent. moisture, a loss of one grade point occurred. When brine concentration was increased to a level of approximately 14.0 per cent., quality deteriorated by a further ½ pt. This degree of quality deterioration at higher salt concentrations was constant for butters of differing initial quality.

I. INTRODUCTION

The influence of salt on the flavour of foods is well established in practice. "Saltiness" is accepted as one of the four basic sensations of taste. The mechanism of salt action in the determination of flavour, however, is not clearly established, largely because the flavour of a food is a composite of the senses of taste, smell, sight and touch and as yet knowledge of the chemistry of flavouring substances is incomplete.

McDowall (1953) reported that it is factory practice in Australia and New Zealand to vary the level of salt content of butter between seasons. In spring months in particular, levels are reduced to as low as 1·1 or 1·2 per cent. to minimize the intensity of feedy off-flavours, mainly clover taints, although any endeavour to maintain consistently low concentrations is influenced by over-run considerations. Analyses of butters from Queensland factories revealed the mean salt content to be 1·41 per cent. in 1958-59 and 1·40 per cent. in 1959-60. The average salt level for the individual factories, however, ranged from 1·04 to 1·81 per cent. and 0·94 to 1·85 per cent. for the respective years. It has also been noted that butters entered for competitions have a markedly reduced salt content, and generally the butter awarded the highest points contains the lower salt concentrations. A second revealing feature regarding the relationship of salt to the flavour of butter is the increased quality of high quality butter which is manufactured when shipments of unsalted butter are required for export markets.

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The incidence of weed off-flavours in Queensland butter is most severe and highly seasonal in nature (Mitchell 1960), and it has been an accepted advisory recommendation to manufacturers to decrease the salt content during the critical period (Pitceathly 1960). It is also during this period of severe weed off-flavours that consumer complaints concerning unsatisfactory flavour in butter are more frequent.

To ascertain the influence of salt on the perception of weed flavours in butter, and to compare the effect of different levels of salt on the intensity of these off-flavours, a series of laboratory and commercial factory churnings were manufactured during the winter-spring period of 1960.

II. METHODS

(1) *Salting.*—As the normal level of salt content of butter approximated 1·5 per cent., trial churnings in each series were prepared at levels of 0·7, 1·0 and 1·5 per cent., representing very low, low and normal content respectively. Samples of unsalted butter were also prepared in laboratory trials. Plasticized pats containing approximately 2·2 per cent. salt were prepared from commercial bulk churnings.

(2) *Analytical.*—In all instances, only raw cream which had been graded and processed as choice quality was used for butter manufacture. This precaution was necessary to eliminate any masking effect on weed flavours by off-flavours associated with low quality creams. Moisture and salt content of samples were determined by the Kohman (1919) method and in the case of factory samples moisture distribution was determined by the Muller (1952) microscopic technique.

Isolated samples of plasticized pats were analysed for composition. As all butter supplies to this plant are standardized on laboratory analysis, the results obtained were considered typical of all butter examined.

(3) *Laboratory Manufacture.*—Laboratory pats were prepared from washed butter grain collected on churning day from a nearby factory. Separate portions were blended with a measured quantity of granular salt and/or moisture in a household electric mixer to provide both the unsalted sample and the butters with the three levels of salt content. Pats of approximately 1 lb were manufactured.

In most of the trials, samples of the factory manufacture from the original butter grain were also collected for comparative analyses and grading. This was done to check the accuracy of manufacturing techniques of laboratory churnings, as some difficulty was experienced in ensuring that laboratory samples were free from traces of mottle defect.

(4) *Commercial Manufacture.*—Trial churnings under commercial conditions were manufactured in the Esk, Proston and Chinchilla factories, each of which is situated in a district adversely affected by weed growth. Because of a shortage of sufficient supplies of choice quality cream for comparative churnings, only a small number of samples were prepared at Proston and Chinchilla factories.

Experimental cream for churning was processed in bulk and divided into three separate churnings for manufacture. As it is not normal procedure in Queensland factories to analyse butter for salt content, the method of salting followed regular practice in which a weighed quantity based on the estimated loading is added. This procedure did result in slight variations from the desideratum in the final salt content of comparative churnings.

Bulk butter from each factory was forwarded to Brisbane, where it was prepared by the Abel vacuum process (Gunnis 1959) for distribution on the local market. The salt content of these plasticized pats approximated 2·2 per cent. and moisture content was 15·8 per cent. Samples were compared for quality with the initial bulk supply.

(5) *Grading.*—All samples were graded within 4–7 days after manufacture by a panel of two or three qualified graders. Grading comments were confined to a description of weed off-flavours, and differences in quality of the order of ¼ pt. were recorded.

III. RESULTS

As the salt added to butter becomes distributed finally in the form of brine, grading results in this investigation were related to brine concentration of the respective butters. No determination of brine concentration was undertaken, this value being calculated from the salt and moisture analyses of each sample. Assuming that the salt and moisture are evenly distributed throughout the butter, salt levels of 0·7, 1·0, 1·5, and 2·2 per cent. in a butter of 15·8 per cent. moisture correspond to brine concentrations of 4·43, 6·33, 9·49 and 13·92 per cent. respectively.

(a) Salted v Unsalted

The results of 19 laboratory comparisons of unsalted and normal salted churnings are listed in Table 1. Mean brine concentration of the normal churnings was 9·60 per cent. Grade score for salted churnings fell from 92·71 to 91·78, i.e. 0·93 pt. lower than that obtained for the unsalted butter from identical cream.

TABLE 1

MEAN GRADE SCORE OF UNSALTED AND SALTED ("NORMAL" LEVEL) BUTTERS

No. of Churnings	Unsalted		Salted			
	Grade Score (pt.)		Grade Score (pt.)		Brine Concentration (%)	
	Range	Mean	Range	Mean	Range	Mean
19	92–93	92·71	91–92·75	91·78	8·82–10·82	9·60

TABLE 2

MEAN GRADE SCORE OF BUTTER SALTED AT DIFFERENT LEVELS (LABORATORY MANUFACTURE)

Brine Concentration Range (%)	Unsalted Grade (93 pt.)			Unsalted Grade (92½ pt.)			Unsalted Grade (92 pt.)		
	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)
< 4·00	1	3·60	93·00	..	..	..	..	..	..
4·00– 5·49	6	4·66	92·89	4	4·65	92·38	3	4·61	92·00
5·50– 6·99	4	6·45	92·50	3	6·88	92·00	2	6·35	92·00
7·00– 8·49	4	7·15	92·56	2	7·77	91·38	1	7·88	91·00
8·50– 9·99	4	9·24	92·13	3	9·27	91·33	2	8·98	91·25
10·00–11·49	2	10·22	92·00	..	..	..	..	..	..
11·50–12·99	..	..	..	..	..	..	1	12·40	91·00

(b) Levels of Salting

(1) *Laboratory Manufacture.*—Details of brine concentrations and grade scores of small-scale laboratory churnings are given in Table 2 and Figures 1-3. As the influence of salt content on the perception of taint could be dependent on the initial quantity of tainting fraction present in the butter, grade scores were analysed according to the grade of the related unsalted churning.

Seven series of churnings were prepared from butter which scored 93 pt. as unsalted. At brine concentrations below 5·0 per cent., four churnings remained true-to-grade, two lost ¼ pt. and one decreased in quality by ½ pt. In two series, butter remained choice grade until a brine concentration of 6·4 per cent. was reached.

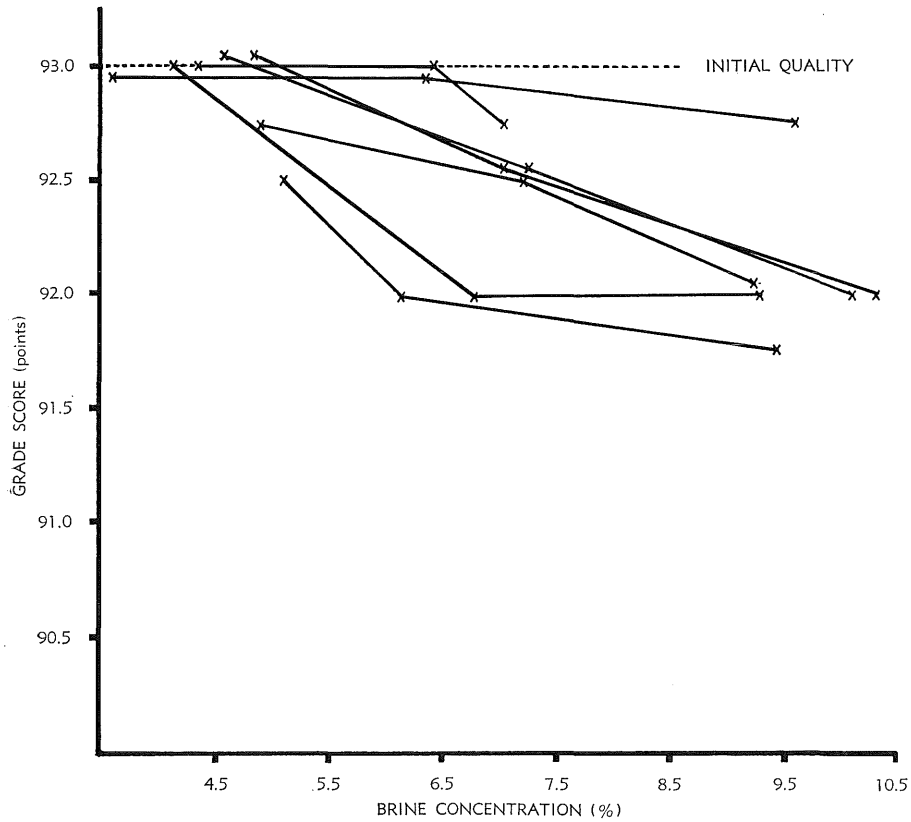

Fig. 1.—Grade scores of butters salted at various brine concentrations. (Unsalted initial quality 93 points.)

With butter which scored 92½ pt. as unsalted, a similar true-to-grade pattern was found. Below a brine concentration of 5·5 per cent., three of the four series manufactured lost only ¼ pt. or less, while the fourth sample scored 91½ pt., a loss of 1 pt.

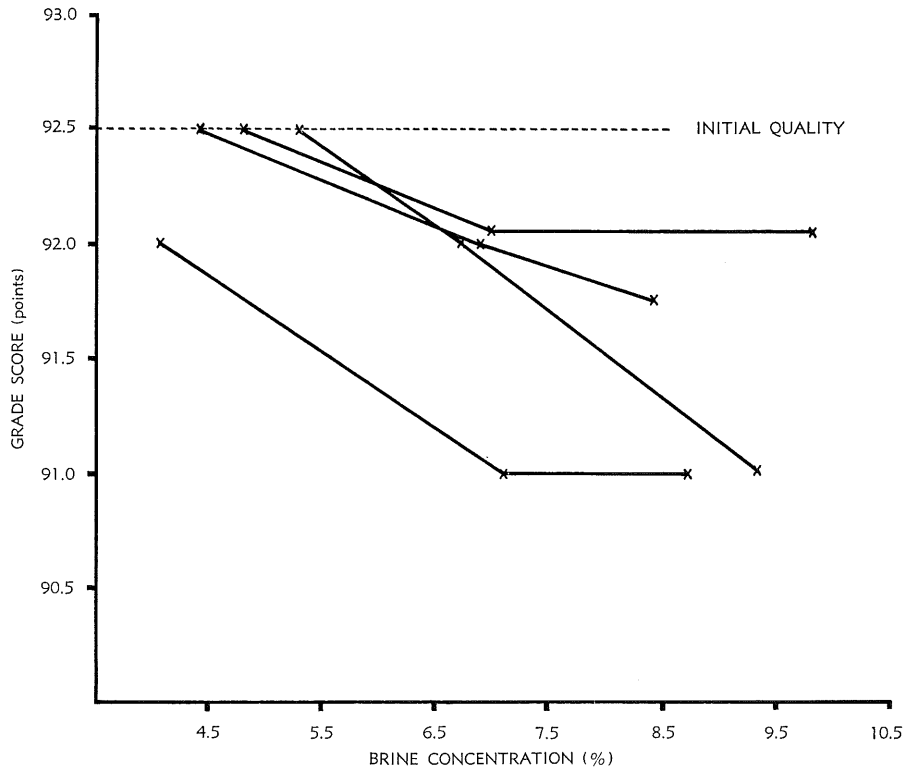

Fig. 2.—Grade scores of butters salted at various brine concentrations. (Unsalted initial quality 92.5 points.)

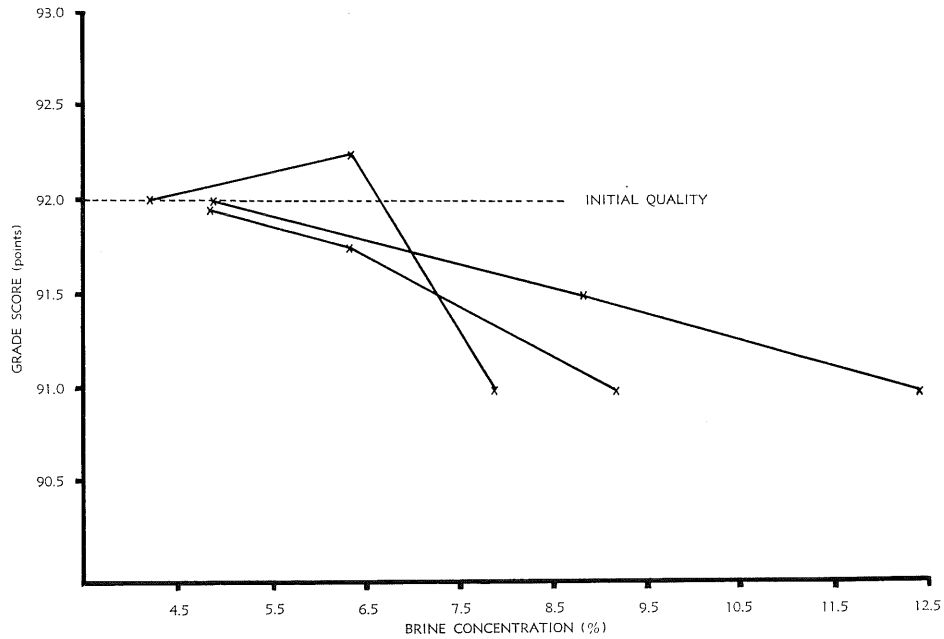

Fig. 3.—Grade scores of butters salted at various brine concentrations. (Unsalted initial quality 92 points.)

Only three series of butters were manufactured from butter grain which scored 92 pt. in an unsalted condition. Each churning retained its grade score at its original level at brine concentrations below 5·0 per cent., and one pat actually improved its score by ¼ pt. at a brine level of 6·3 per cent.

Results of the grade scores of laboratory churnings and commercial manufacture from identical butter grain salted at similar brine concentrations are listed in Table 3 and indicate a satisfactory comparison.

TABLE 3

COMPARATIVE GRADE SCORE OF LABORATORY AND COMMERCIAL BUTTERS SALTED AT "NORMAL' LEVEL

Unsalted		Salted			
Grade (pt.)	Trial No.	Laboratory Manufacture		Commercial Manufacture	
		Grade (pt.)	Brine Concentration (%)	Grade (pt.)	Brine Concentration (%)
93	9	92·75	9·59	92·5	8·85
	11	92	9·24	92	10·82
	6	91·75	9·43	92	10·44
	14	92	10·33	92	10·60
92·5	4	91	9·32	91	9·14
	5	91·75	8·42	91·75	8·20
	7	92	9·80	92	9·30
Mean 92·79	..	91·83	9·45	91·89	9·62

(2) *Commercial Manufacture.*—Results of trial churnings manufactured in the three commercial factories and of 1 lb print samples prepared in the patting plant are shown in Table 4 and Figures 4-5. It was not possible with this series of churnings to prepare samples of unsalted butter for comparison.

As with laboratory trials, it was noted with butters of low brine concentration that the majority of churnings maintained their initial grade score up to a brine concentration of 5·0-5·5 per cent. Deterioration in quality for individual series, however, was variable. Several churnings maintained their initial grade with brine concentrations up to 9·5 per cent.

At Factories A and B, where sufficient churnings were available in each brine range to permit comparisons, a decrease in brine concentration from a normal level to a low level improved the grade score by an average of 0·25 and 0·54 pt. respectively. When the salt content was reduced to a very low level, butter quality in comparison with the normal grade score was increased by 0·83 and 0·61 pt. respectively.

TABLE 4

MEAN GRADE SCORE OF BUTTERS SALTED AT DIFFERENT LEVELS (COMMERCIAL MANUFACTURE)

Brine Concentration Range (%)	Factory A			Factory B			Factory C		
	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)	Number of Churnings	Mean Brine Concentration (%)	Mean Grade Score (pt.)
< 4·00	..	..	..	..	..	..	1	3·85	93·00
4·00– 5·49	1	5·03	93·00	5	4·65	92·50	1	4·46	92·00
5·50– 6·99	3	6·37	92·42	7	6·23	92·43	..	..	..
7·00– 8·49	3	8·27	92·00	6	7·70	92·21	3	7·81	92·00
8·50– 9·99	3	9·42	92·17	7	9·05	91·89	1	9·62	92·50
10·00–11·49	2	10·83	92·00	1	10·13	91·75	..	..	..
11·50–12·99	..	..	..	..	..	..	..	..	..
13·00–14·49	3	14·00*	91·67	8	14·00*	91·38	2	14·00*	91·50

* Brine concentration estimated on basis of 2·21 per cent. salt in a butter of 15·80 per cent. moisture.

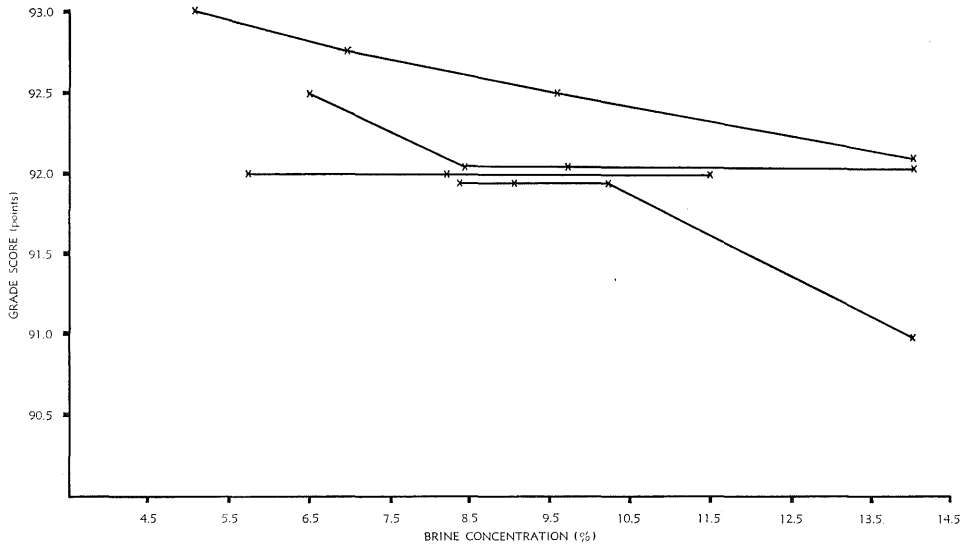

Fig. 4.—Grade scores of butters from Factory A salted at various brine concentrations.

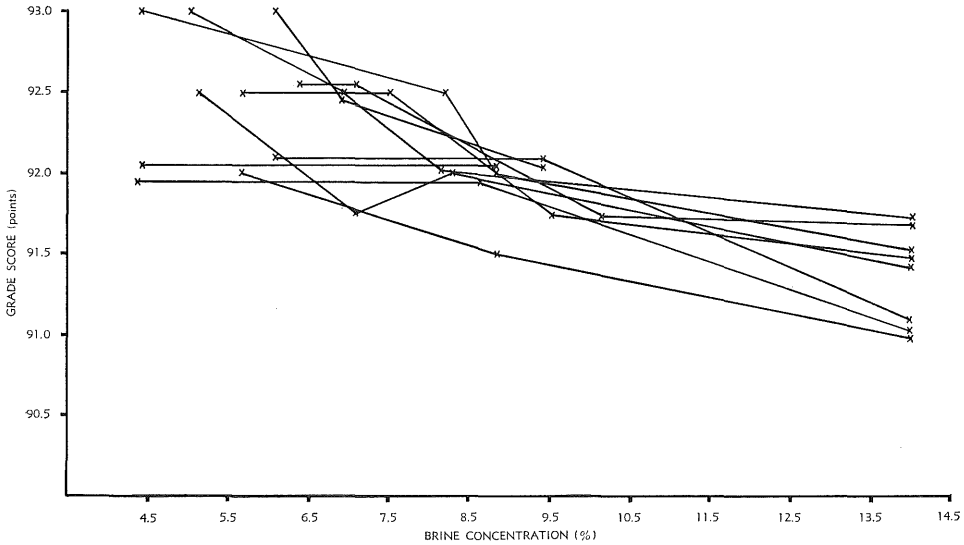

Fig. 5.—Grade scores of butters from Factory B salted at various brine concentrations.

The influence on butter quality of the higher brine concentrations of 14·0 per cent. provided in butters standardized and processed in the Abel vacuum plasticizers for local sale was similar to that obtained at the lower levels. Butters of normal brine concentration (9·5 per cent.) lost approximately ½ pt. when the salt content was increased to this higher level. With butters where initial brine concentrations were low, losses of the order of 1 pt. were shown to occur.

All samples of commercially manufactured butters had a satisfactory distribution of moisture.

IV. DISCUSSION

Several methods of control have been proposed for the reduction of weed taints in both cream and butter (Conochie 1950; McDowall 1953; Major 1960). These recommendations, however, have limited application under Queensland conditions, where the infestation of grazing areas with tainting weeds is severe, the quantities of weed-tainted cream received by a factory are considerable, the supply of high-acid creams necessitates high intensity processing treatments, and detection of weed taints in fresh cream by the conventional tasting methods is difficult.

This investigation has demonstrated that where cream is strictly graded and the subsequent butter is salted at a brine concentration of 5·0 per cent. or lower, choice quality can be obtained even if small quantities of weed-tainting substances are present in the raw cream. However, as the financial returns at present received for first quality butter are not markedly lower than those obtainable for choice quality, it would appear there is no direct economic advantage in supplying butter free from these taints in the weedy season.

From a quality consideration, there is also merit in reducing the brine concentration from the high level of 14·0 per cent. normally aimed for in plasticized butter pats when initial butter quality is of the order of 92 pt. Here also economic considerations influence the adoption of lower salting practices, as at present a similar price is obtainable for butters of 90 pt. quality and higher sold on the domestic market. Since retail experience shows consumers are able to detect the increased taint evident in weed-affected butters when brine concentrations are high, a true economic analysis is difficult unless some measure of any reduction in sales volume during this weed season is available.

Where low brine concentrations are sought, it is essential that moisture content be maintained at the maximum legal limit to enable the largest amount of salt consistent with the desired brine concentration to be added.

V. ACKNOWLEDGEMENTS

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