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ผลของน้ำตาลทรีฮาโลสต่อคุณภาพเนื้อปลาแล่และเนื้อปลาบดแห้ง

The Effect of Trehalose on the Quality of Dried Fish Fillet and Mince

เอกสารทางวิชาการ ฉบับที่ 5/2537
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สารบัญ

สารบัญ ตาราง รูป และภาคผนวก

ผลของน้ำตาลทรีฮาโลส (Trehalose) ต่อคุณภาพเนื้อปลาแล่และเนื้อปลาบดแห้ง

THE EFFECT OF TREHALOSE ON THE QUALITY OF DRIED FISH FILLET AND MINCE

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บทคัดย่อ

ได้ทดลองศึกษาผลของ Trehalose ต่อคุณภาพเนื้อปลาแล่และเนื้อปลาบดแห้ง ซึ่งใช้ปลาคอดเป็นวัตถุดิบและอบแห้งโดยเครื่องอบแห้ง 2 แบบคือ เครื่องอบแห้งที่ใช้ไฟฟ้า (Mechanical Dryer) อุณหภูมิ 30°C และเครื่องอบแห้งพลังงานแสงอาทิตย์เทียม (Solar Dryer หรือ Simulated Sun Dryer) ที่อุณหภูมิ 40°C โดยนำตัวอย่างปลาคอดแล่มาแช่ในสารละลาย Trehalose ที่ระดับความเข้มข้น 0, 0.6 และ 6% โดยน้ำหนัก และนำปลาคอดบดผสมกับ Trehalose ที่ระดับความเข้มข้น 0, 0.6 และ 6% โดยน้ำหนัก และนำไปทำให้แห้งจนกระทั่งน้ำหนักของผลิตภัณฑ์แห้งคงที่

ตัวอย่างทั้งหมด ได้นำมาวิเคราะห์หาปริมาณน้ำอิสระ (Water Activity, Aw.) พบว่า ตัวอย่างปลาแล่แห้งมีค่า Aw. 0.7-0.8 ส่วนเนื้อปลาบดแห้งมีค่า Aw. 0.4-0.5 ส่วน Trehalose และวิธีการทำแห้งไม่มีผลต่อ Rehydration Ratio ของทุกตัวอย่าง ตัวอย่างปลาบดแห้งที่ผสมด้วย Trehalose 6% มีปริมาณ Trehalose 248-286 mg/gm (9-10% Trehalose ต่อน้ำหนักแห้ง) ที่วิเคราะห์โดยวิธี Anthrone Colour-Developing Reagent สำหรับ Drying Performance ระหว่างการทำแห้งของตัวอย่างปลาแล่ และปลาบดโดยใช้การทำแห้งแบบ Mechanical Dryer และ Solar Dryer พบว่าตัวอย่างที่ใส่ Trehalose 6% จะมีอัตราการสูญเสียน้ำช้ากว่าตัวอย่างที่ใส่ Trehalose 0.6% และไม่ได้ใส่ Trehalose. เนื้อปลาแล่และเนื้อปลาบดแห้งที่ใส่ 6% Trehalose และอบแห้งด้วย Mechanical Dryer เมื่อนำมาคืนตัวในน้ำแล้วพบว่าลักษณะทั่วไป สี กลิ่น และเนื้อสัมผัสไม่ต่างจากเนื้อปลาสด และ Trehalose ไม่มีผลต่อลักษณะทั่วไป สี และเนื้อสัมผัสของตัวอย่างผลิตภัณฑ์แห้งที่ใช้ Solar Dryer ส่วนกลิ่นของตัวอย่างปลาแห้งที่ผ่านการแช่น้ำแล้วไม่ต่างจากเนื้อปลาสด และกลิ่นของเนื้อปลาแห้งที่แช่น้ำแล้ว เมื่อทำให้สุกก็ไม่ต่างกันกับของเนื้อปลาสดที่ทำให้สุกแล้วเช่นกัน

Abstract

Treatment of cod fillet and mince prior to mechanical drying (30°C) and solar drying (40°C) was carried out by either soaking the fillet sample in a solution containing 0, 0.6 and 6% w/w trehalose, or rubbing 0, 0.6 and 6% trehalose w/w into the mince sample. The water activity of dehydrated sample were 0.7-0.8 and 0.4-0.5 for dried fish fillet and mince respectively. The rehydration ratios of the fish were not affected by the trehalose and method of drying. The trehalose content obtained from dehydrated mince sample mixed with 6% trehalose was about 248-286 mg/gm sample (9-10% trehalose dry basis) by using the anthrone colour-developing reagent method. Drying performance for fillet and mince dried samples, the moisture loss of samples treated with 6% trehalose was slower than that of the other samples both for mechanical and solar dryer. Rehydrated 6% trehalose mechanically dried sample was found to have no significant difference on appearance, colour, odcur and texture with the fresh fish. There was no significant effect of trehalose on appearance, colour and texture of sample dry in solar drying. There was no significant difference between the odours at rehydrated and cooked rehydrated samples and fresh fish.

Introduction

1. Trehalose is a disaccharide non reducing sugar made up of 2 molecules of glucose that are linked by thier reducing carbons. It is able to protect plants from damage when they dry out. Trehalose is non toxic and has the ability to form a glass during drying. This entraps volatile food aromatics which are released when the dried product is reconstituted with water (Roser, 1993). Trehalose does uot caramelise and cannot undergo millard reaction with protein and peptides (Roser, 1991).

2. Trehalose occurs naturally in many widely consumed foods. It is present in mushrooms (Birch, 1970) yeast product as bread (Oda, 1986).

3. Blended fresh eggs, dried with trehalose at 30°C to 50°C produce an odourless yellow-orange powder that can be stored at room temperature. After rehydration the product is almost indistinguishable from a fresh egg. Dried purees of bananas, strawberries, mangoes, avocadoes, apples and rassberries with trehalose. When dried powder is reconstituted even after prolonged storage, it recovered the colour on other properties of the original.

4. Roser has soaked banana slices in a solution of trehalose, and then air-dried. The slices retained their colour and structure for more than a year at room temperature (Roser, 1993).

5. As the properties of trehalose on the quality of dried products. It is interesting in using trehalose for dried fishery products because the pattern for fish utilisation in Thailand are mainly consumed fresh and cured (salted, dried, steamed, smoked) and curing products accounted for about 10% of the total marine fish production (2.5 million metrictons).

6. Dried fishery products usually by air drying which is cheap and simple, but it usually changes the taste, colour, texture and aroma of products and can not be reconstituted with water as fresh food.

7. Therefore, this experiment is designed to improve the quality of dried fishery products by using trehalose.

8. The objective of this study are to investigate the effect of trehalose quantity on the quality of dried fish fillet and mince and to obtain the drying performance of treated and untreated trehalose dried products.

Material and Methods

Dehydrated sample preparation

9. The cod (Gadus morhua), 2-3 kilograms each was obtained from a fish monger and used as raw material for this experiment. The cod were washed with cold water to remove the slime and filleted without skin. The fillets were trimmed by removing the belly flap. Each fillet was cut into a small fillet with 1 x 3 x 1cm in width, length and thickness and divided into three parts. Care was taken to ensure that the sample from the same fillet were provided for each treatment. Each part of sample obtained 100 small fillets. The flesh left from strip cutting about 3 kilograms mince by using electric mincer.

10. The fillet samples were treated with 0, 0.6 and 6% trehalose (-D Glucopyranosyl -D-Glucopyranoside). Dehydrated from saccharomyces cerevisiae by making the solution and the fish strips were soaked for dehydrated in mechanical dryer at temperatures 29-30°C and solar dryer, at temperature 39-40°C. This solar dryer is simulated sun drying and consists of a compact array of twenty-eight Thorn 1 KW CSI gas discharge lamps, electrical control gear, instrumentation and data logging equipment, the array is operated 5.5m above the working area which can be irradiated to an intensity approximately Air Mass 1 (1000 W/m^2) with a uniformity better than ±10%.

11. Each one kilogram of minced sample mixed with 0, 0.6 and 6% of trehalose for 10 mins and making in to thin sheets by using rolling pin and divided into 2 parts for dehydration the same as fish strips.

12. During the drying period the fish weight were recorded at about 3 hour time intervals to determine drying performance of products. And all samples were dried until there was no further appreciable weight loss.

Sample Analysis

13. The moisture content of the fresh fish, dehydrated and rehydrated sample determined by oven method (A.O.A.C., 1990).

14. The water activity of the dehydrated sample was determined by Aw-Value Anlyzer Model 5803.

15. The rehydration ratios of the dry fish was determined by the method of Loesecke (1995) and expressed as the ratio of rehydrated weight to the dry weight.

16. The amount of trehalose in dry sample was analysed by adding 20ml of water in dry sample, homogenizing it, then stirring for 1 hour in cold room and centrifuge at 10,000 rpm for 20 mins at 6°C. The supernatant was frozen until required for the anthrone colour-developing reagent method. The sample and reagent were cooled to 0°C before mixing, and heated for 10 mins in a boiling water-bath. The sample and standard trehalose solution were measured in SP8-400UV/VIS spectrophotometer at a wavelength of 625nm, using 1cm cells (Herbert, 1971).

Sample Preparation For Sensory Analysis

17. Twenty pieces of sample from each treatment were used for sensory evaulation and were taken from the same lots as those used for moisture and rehydration analysis. The samples were soaked in water and kept in refrigerator at 0°C for 30 hours. The soaked samples were drained for sensory analysis. The fresh cod was prepared as a control samples, cut the same dimension as the dehydrated sample. The half of rehydrated and fresh sample were used for sensory evaluation. The panelists were asked to examine each sample treatment for appearance, odour, colour and texture and give a score according to the description of fresh fish by Howgate (1982) and Torry Advisory note no. 91 (Annex 1, 2).

18. The other half of samples used for cooked sensory analysis. The sample was put in high density polyethylene bag for 1 piece each and the bag were placed in pyrex beaker and immersed in water and cooked in microwave at 100% heat for 5 minutes. The panelists were asked to examine each sample treatment for odour and texture and give a score according to the description of cooked fish by Howgate (1982).

Statistical Analysis

19. The data were analysed to ascertain whether there was any differences between the sample treatments. Analysis of variance and the least significant difference were employed for evaluating (Alder, 1977).

Result and Discussion

Sample Analysis

20. Moisture content of fresh cod was 82.37%. The fish fillet treated with trehalose and without trehalose were dried for 26 and 11 hours for mechanical and solar dryer until no further weight loss occured. The moisture content of the dried product was between 19-28% (Table 1). The samples dried in mechanical dryer had a lower moisture content than the solar dried sample. This was presumably due to the temperature of solar dryer being about 40°C, and the sample underwent case hardening. This is caused by the initial drying being too rapid, and causing the outer layer to harden before the moisture in the deeper layers has had an opportunity to diffuse to the surface (Trim, 1983). In contrast, the dried mince sample in the solar dryer had the lower moisture content (6%) than those in the mechanical dryer (9%) because the sample was in the thin sheet, and did not case harden during drying period (Table 2).

21. The water activity (Aw) of dehydrated samples were about 0.7-0.8 for dehydrated fillets and 0.4-0.5 for dehydrated mince samples (Tables 1 and 2). The dried mince samples can be kept longer than dried fish fillet. As the result of the stability of dried food products depends on their water activity. Most spoilage bacteria will cease to grow in a food whose Aw is below 0.9 and the growth of most moulds is inhibited below 0.8 (Bone, 1969).

22. Trehalose was added to samples prior to drying by either soaking the samples in a solution containing 0, 0.6 and 6% w/v trehalose, or rubbing 0, 0.6 or 6% trehalose w/w into the samples. Results obtained from samples which soaked in 6% trehalose solution for 3 hours showed they contained 86-94mg/gm sample (3.3-3.9% trehalose dry basis). The higher trehalose content obtained from dehydrated mince sample mixed with 6% trehalose was about 248-286mg/gm

sample (9-10% trehalose dry basis) (Table 3). The fresh fillets could not adsorb all trehalose from solution. The trehalose penetrated to the fish according to the time of soaking and the size of sample. If the size of fillet is thinner and the soaking period is longer. The trehalose content of samples might be higher. Certain mushrooms contain up to 20% trehalose in dry sample are indefinitely stable on storage in the dry state at room temperature and promptly rehydrate to give a fresh product (Roser, 1991).

23. The rehydration properties of fish fillet and fish mince were not affected by the amount of trehalose and the drying method. Measurement of the rehydration ratio of dry samples used in these experiments showed no significant difference between the control and the treated samples (Table 3). A similar result obtains from the rehydration properties of fruits and vegetables treated by surfectants as shown by Saravacos (1962). The rehydration ratio of all samples was about 2 (50% of original state). Not all products reconstitute to 100% of their original state because of inherent differences in their chemical composition (Loesecke, 1955). The moisture content of cooked rehydrated fish fillet and mince was 68-71% and 73-81% respectively (Table 4 and 5).

Drying performance

24. The moisture loss for fillet and mince samples treated with 6% trehalose was slower than that of the other samples, both for mechanical and solar dryer (Figure 1-4). Fish has a homogeneous structure, the trehalose did affect the drying rate because the resistance to moisture transfer is exhibited by the mass of material. The drying period until there was no further weight loss for fish fillet about 26 hours but only 11 hours for solar dryer.

Sensory Evaluation

Rehydrated sample fillet

Appearance

25. There were significant differences ($P<0.05$) on appearance among sample without trehalose and 0.6% trehalose with the fresh fish fillet and sample with 6% trehalose dried by mechanical dryer (Figure 5). The fresh fillet and rehydrated 6% trehalose mechanical dried sample had translucent flesh but the sample with 0.6% trehalose and without trehalose both from mechanical and solar dryer had lost its translucent flesh and there was some waxy appearance and opacity. There was no significant difference in appearance among samples with trehalose 0.6 and 6% without trehalose using the solar dryer. The samples had lost translucent flesh. Because of the temperature of solar dryer was too high about 39-40°C, resulting in protein denaturation, case hardening also occured. Trehalose did not improve the quality of samples after the sample was reconstituted. But the reconstituted sample with 6% trehalose obtained as fresh fish. It might be due to the temperature of mechanical dryer about 30°C was suitable for drying fish which did not denature protein. At temperature exceeding about 30°C denaturation of protein takes place (Loesecke, 1955).

Colour

26. There was significant difference in colour among samples without trehalose and 0.6% trehalose with the fresh fish fillet and sample with 6% trehalose drying by mechanical dryer (Figure 5). The fresh fillet and rehydrated 6%

trehalose mechanical sample had white colour but the sample without trehalose and 0.6% trehalose both from mechanical and solar dryer had yellow colour. This was presumably due to the occurrence of browning reaction. There is some evidence that the presence of trehalose inhibits the usual browning of protein discoloured the product (Feeney, 1975). There was no significant difference of colour among samples with trehalose 0.6 and 6% and without trehalose by using the solar dryer. All samples had a yellow colour even the sample was treated with 6% trehalose. It might be due to the temperature in the solar dryer accelerating the browning reaction. In this case trehalose had no effect on colour. There was no significant difference in odour among all samples with trehalose, 0.6 and 6% without trehalose both from mechanical and solar dryer with the fresh fillets. All samples had slightly seaweediness odour.

Texture

27. It was very difficult to examine the texture of rehydrated fish fillet by using the descriptive score system for fresh fish because they have different characteristics of elasticity. Therefore, the panelists gave the score of fresh fish as soft flesh and the rehydrated sample had rubbery texture, they gave the higher score as elasticity which it shows the good texture of freshness. However, there was no significant difference on texture score between 6% trehalose sample by mechanical dryer with the fresh fillet. Therefore, it is necessary to develop a descriptive scoring system for texture of rehydrated sample for use during further studies.

Rehydrated Sample (Mince)

Appearance

28. There was no signicant difference in appearance between samples without trehalose and the sample with 0.6% trehalose by mechanical dryer but difference from the sample with 6% trehalose by the same drying method (Figure 6). The sample with 6% trehalose by mechanical dryer had translucent flesh and significant difference with the same amount of trehalose sample by using solar dryer, which lost translucence and there was some waxy appearance. It means that solar dryer at temperature 40°C was not suitable for drying this kind of mince product.

Odour

29. There was no significant difference of odours among all mince samples with trehalose 0.6 and 6% and without trehalose both from mechanical and solar dryer with the fresh mince (Figure 6). All samples had slightly seaweediness odour.

Colour

30. Theree were significant difference in colour between 6% trehalose sample with the sample without trehalose but it was no difference with the sample with 0.6% trehalose by mechanical dryer. There were no significant differences on colour among samples 0.6 and 6% trehalose with the sample without trehalose by using solar dryer (Figure 6). It showed that the higher temperature during drying was more affected on browning reaction when using the appropriate drying temperature. In this experiment the mechanical dryer at temperatures 30°C gave the good result.

Texture

31. There was no significant difference on texture among sample treatments (Figure 6). The samples had softening of the flesh.

Cooked Sample

Odour

32. There was no significant difference on odours among all cooked rehydrate fillet sample with cooked fresh fish. They obtained slight strengthening of the odour but no sour or stale odour (Figure 7).

Texture

33. There was no significant difference on texture between cooked 6% trehalose mechanical dried fillet sample within the cooked fresh fish (Figure 7). Their texture was firm, thick curd, bluish white in appearance and no discolouration. There were no significant difference between the sample without trehalose with the sample with 0.6% trehalose both dry in mechanical and solar dryer, but there was significant on texture between 0.6% trehaclose sample with 6% trehalose sample dry in mechanical dryer but there was no difference between the sample in solar dryer.

34. The trehalose was very effective when dry product as air dry temperature. The protein was not denatured and browning reaction was not occurred. The sample was reconstituted and cooked as fresh fish.

35. For the cooked rehydrated mince sample had got the same results on the odours and texture as for the cooked rehydrated fish fillet (Figure 8).

Conclusion

Trehalose has the ability to protect fish from damage when they dry out. The rehydrated fish with 6% trehalose had the characteristics as fresh fish. Trehalose is of benefit in providing a means of supplying convenient stability to perishable fish. The further study on the quality of dried fish with trehalose at various fish species including shelf life study is strongly recommended.

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Table 1. Moisture content and water activity of dehydrated fillet by mechanical dryer (m.d.) and solar dryer (s.d.)

Treatment	Moisture Content (%)	Water Activity
0% trehalose m.d.	19.79 ± 0.29	0.772
0.6% trehalose m.d.	19.90 ± 0.32	0.769
6% trehalose m.d.	20.22 ± 0.02	0.781
0% trehalose s.d.	26.16 ± 0.06	0.85
0.6% trehalose s.d.	28.54 ± 0.34	0.872
6% trehalose s.d.	26.99 ± 0.19	0.831

Table 2. Moisture content and water activity of dehydrated mince by mechanical dryer (m.d.) and solar dryer (s.d.)

Treatment	Moisture Content (%)	Water Activity
0% trehalose m.d.	9.04 ± 0.09	0.54
0.6% trehalose m.d.	9.06 ± 0.09	0.50
6% trehalose m.d.	9.31 ± 0.18	0.535
0% trehalose s.d.	6.68 ± 0.06	0.45
0.6% trehalose s.d.	6.86 ± 0.14	0.455
6% trehalose s.d.	6.69 ± 0.02	0.45

Table 3. The amount of trehalose in 1gm dehydrated sample

Treatment	mg of trehalose
0% trehalose fillet m.d.	1.45
0.6% trehalose fillet m.d.	6.23
6% trehalose fillet m.d.	94.38
0% trehalose fillet s.d.	0.91
0.6% trehalose fillet s.d.	4.53
6% trehalose fillets.d.	86.53
0% trehalose mince m.d.	1.47
0.6% trehalose mince m.d.	19.78
6% trehalose mince m.d.	248.19
0% trehalose mince s.d.	3.52
0.6% trehalose mince s.d.	29.71
6% trehalose mince s.d.	286.80

Table 4. The rehydration ratio and moisture content of cooked rehydrated fillet

Treatment	Moisture Content (%)	Water Activity
0% trehalose m.d.	2.34 ± 0.04	69.98
0.6% trehalose m.d.	2.29 ± 0.007	71.24
6% trehalose m.d.	2.23 ± 0.007	68.755
0% trehalose s.d.	2.17 ± 0.02	69.44
0.6% trehalose s.d.	2.04 ± 0.11	69.97
6% trehalose s.d.	2.12 ± 0.007	74.55

Table 5. The rehydration ration and moisture content of cooked rehydrated mince

Treatment	Moisture Content (%)	Water Activity
0% trehalose m.d.	2.52 ± 0.06	77.71
0.6% trehalose m.d.	2.47 ± 0.05	79.39
6% trehalose m.d.	2.58 ± 0.063	80.84
0% trehalose s.d.	2.61 ± 0.014	73.16
0.6% trehalose s.d.	2.69 ± 0.08	76.56
6% trehalose s.d.	2.49 ± 0.014	81.10

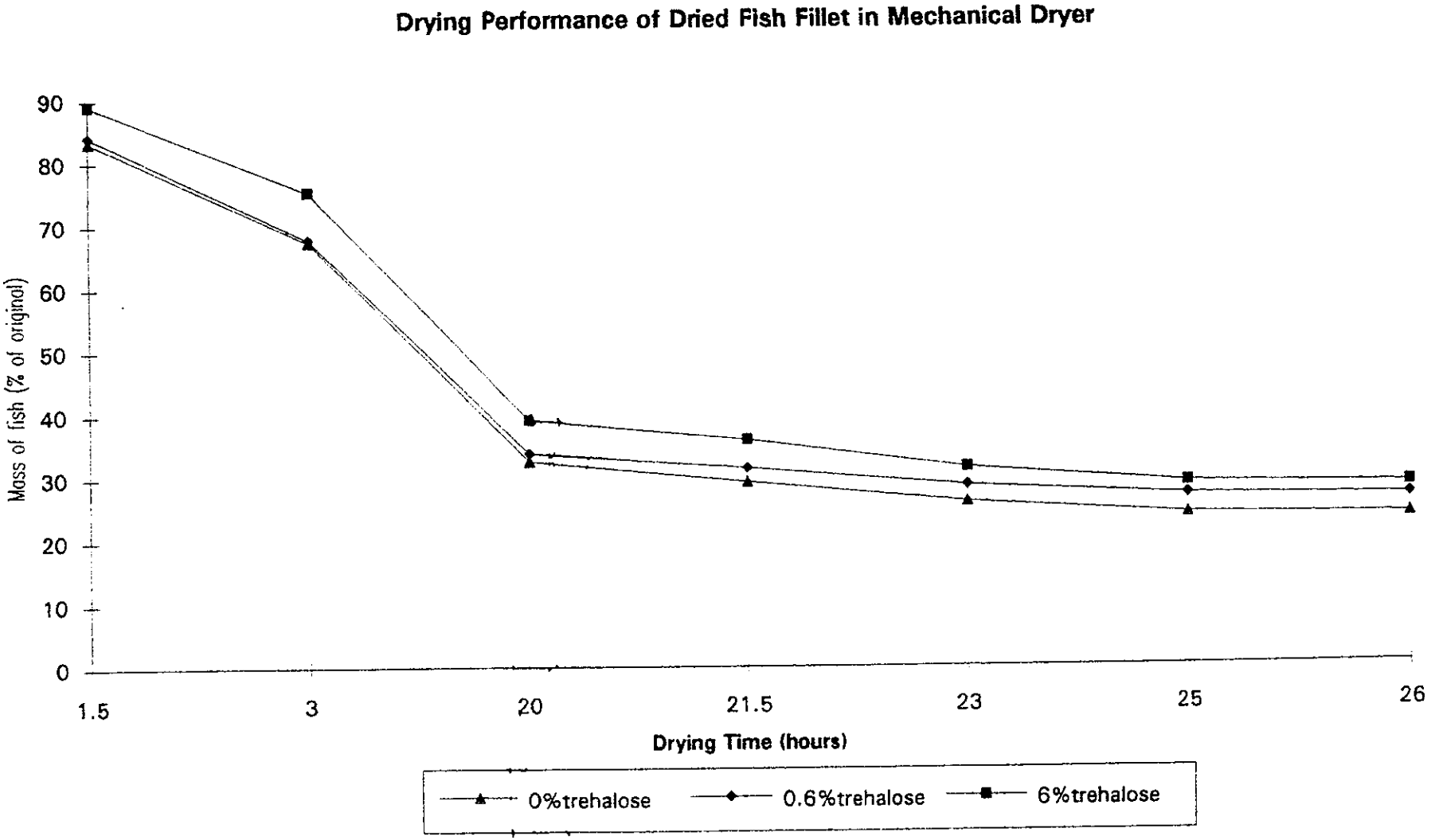
Drying Performance of Dried Fish Fillet in Mechanical Dryer
Mass of fish (% of original)
90
80
70
60
50
40
30
20
10
0
1.5
3
20
21.5
23
25
26
Drying Time (hours)
0%trehalose
0.6%trehalose
6%trehalose

Figure 1

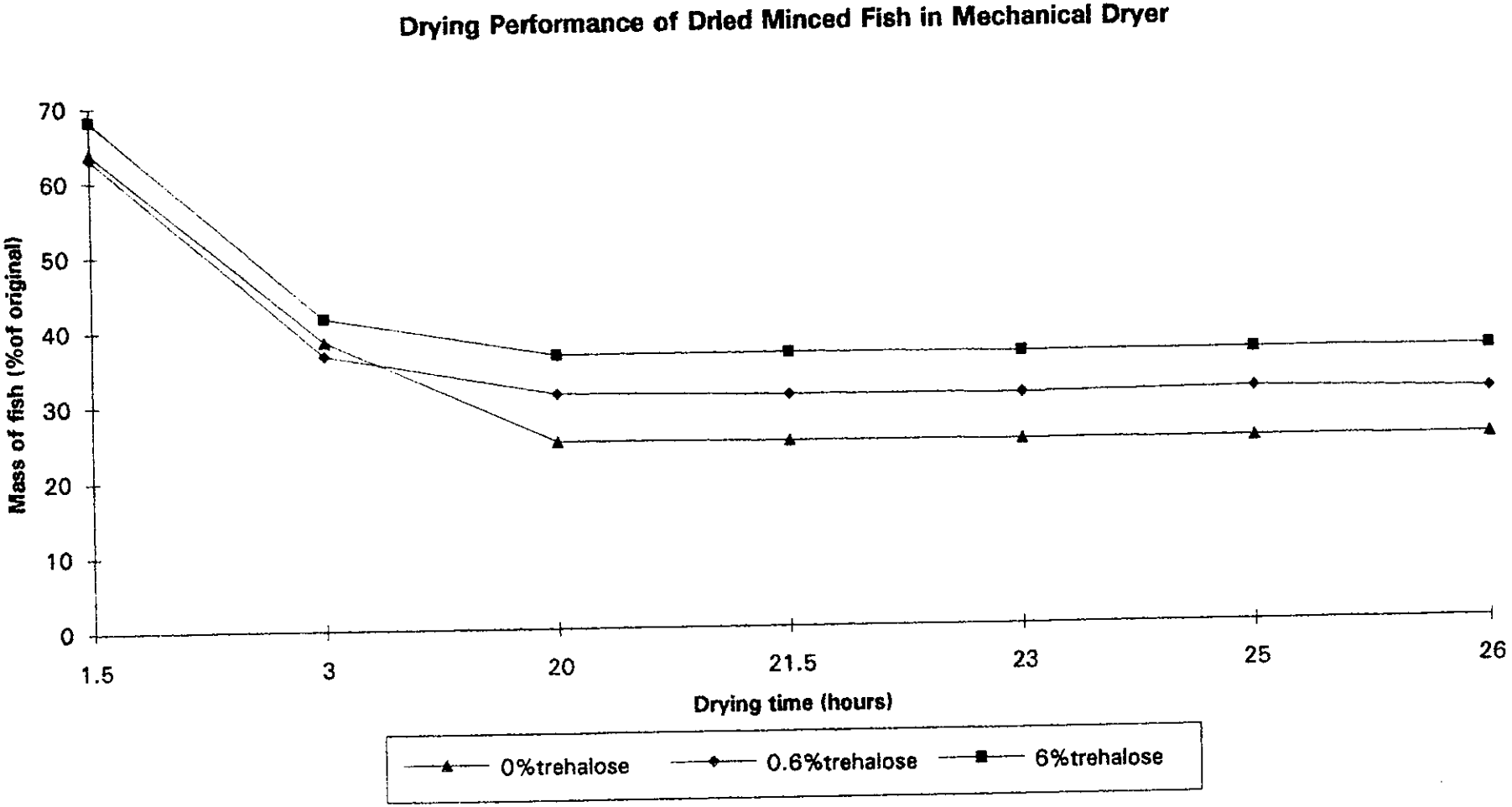
Drying Performance of Dried Minced Fish in Mechanical Dryer
Mass of fish (%of original)
70
60
50
40
30
20
10
0
1.5
3
20
21.5
23
25
26
Drying time (hours)
0%trehalose
0.6%trehalose
6%trehalose

Figure 2

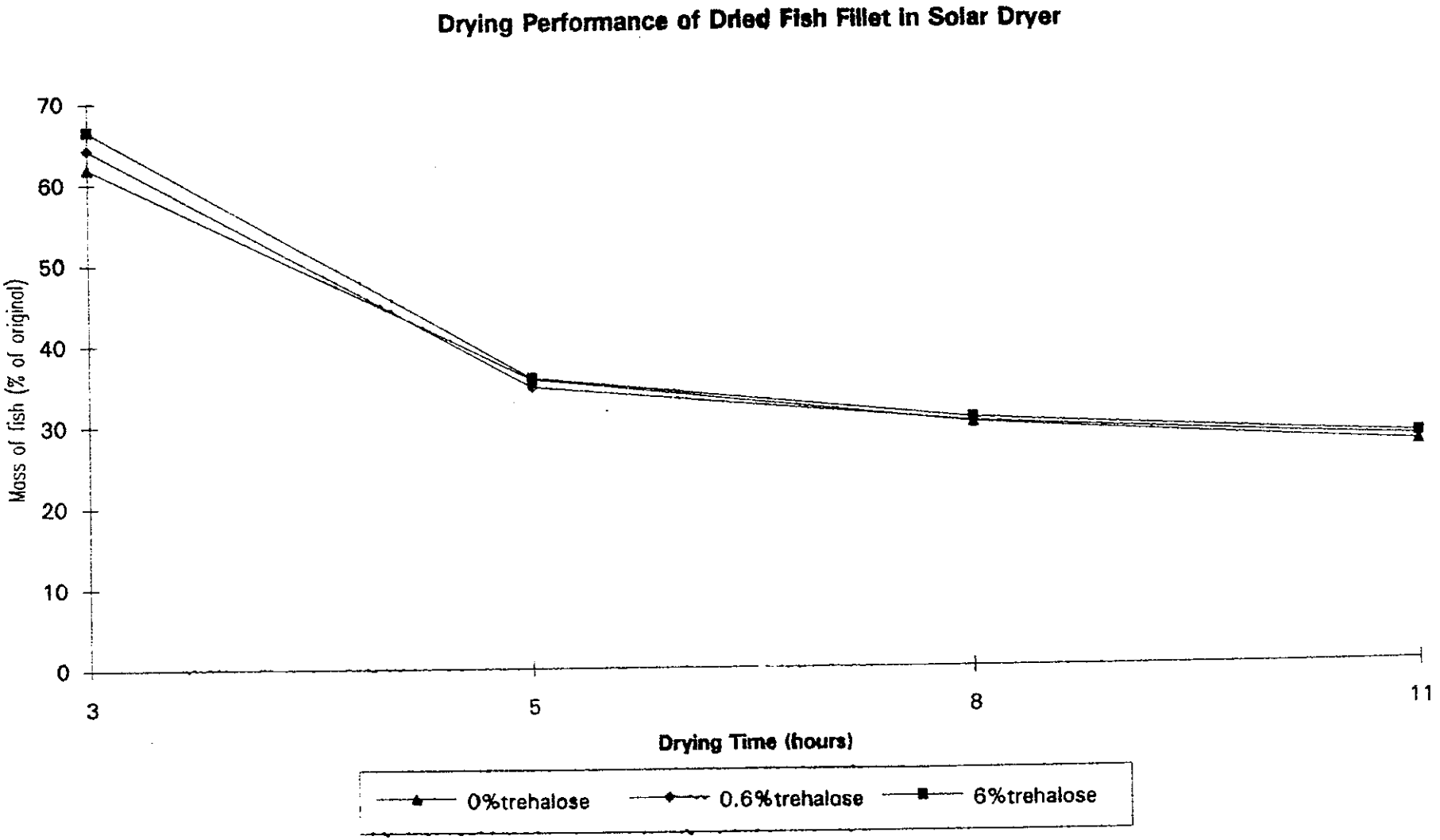
Drying Performance of Dried Fish Fillet in Solar Dryer
70
60
50
40
30
20
10
0
Mass of fish (% of original)
3
5
8
11
Drying Time (hours)
0%trehalose
0.6%trehalose
6%trehalose

Figure 3

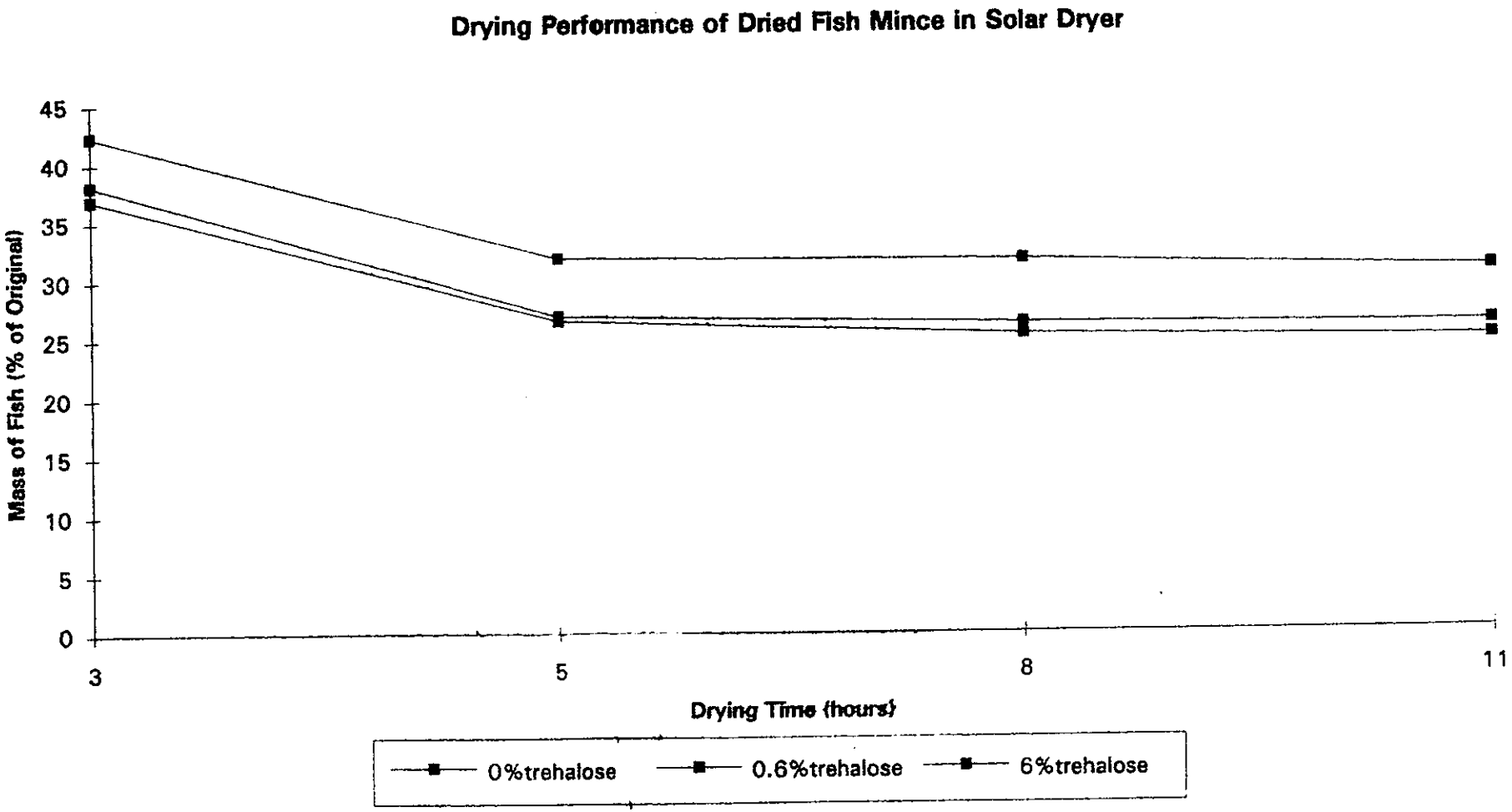
Drying Performance of Dried Fish Mince in Solar Dryer
Mass of Fish (% of Original)
45
40
35
30
25
20
15
10
5
0
3
5
8
11
Drying Time (hours)
0%trehalose
0.6%trehalose
6%trehalose

Figure 4

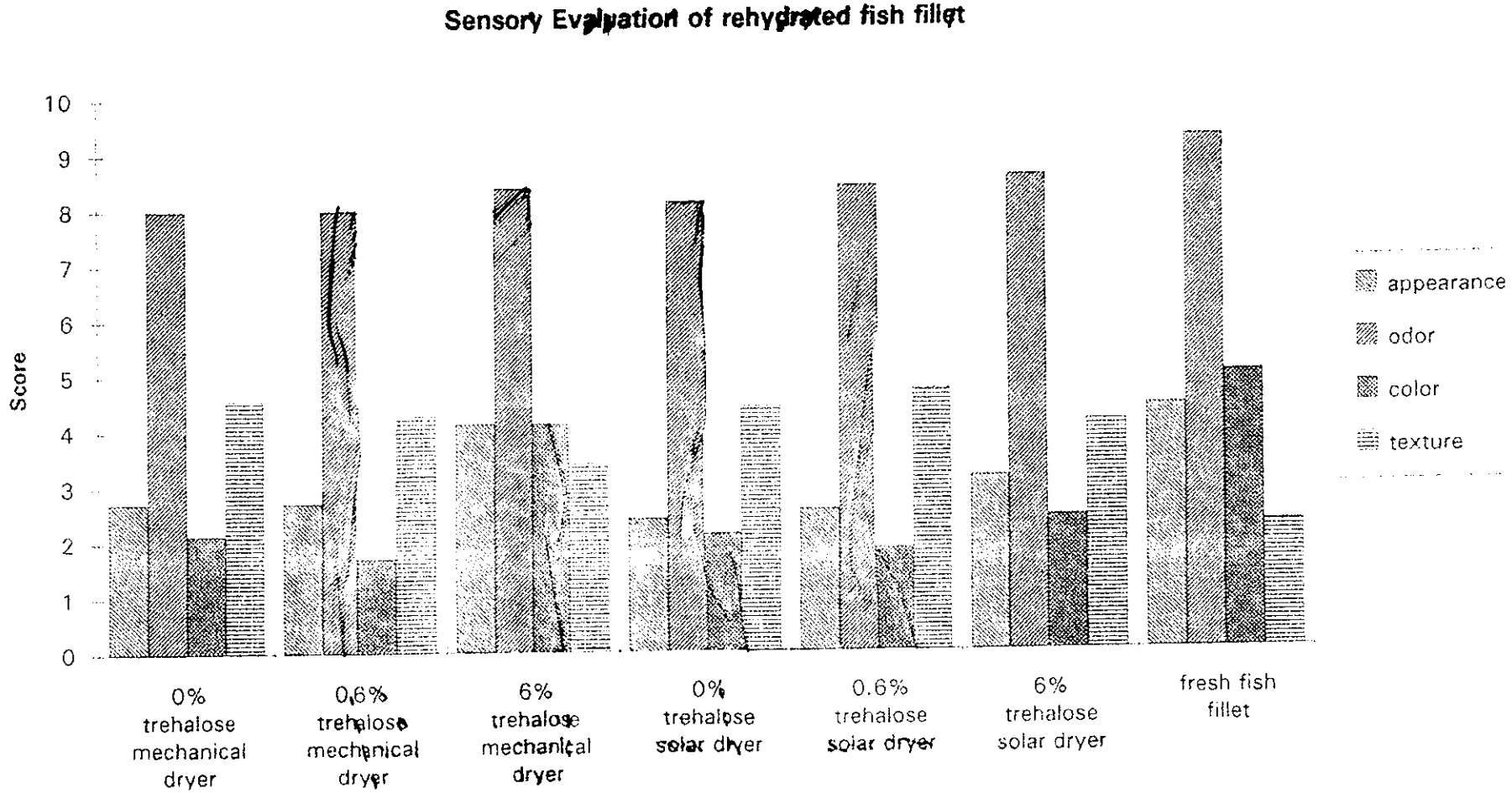
Sensory Evaluation of rehydrated fish fillet
Score
10
9
8
7
6
5
4
3
2
1
0
0% trehalose mechanical dryer
0.6% trehalose mechanical dryer
6% trehalose mechanical dryer
0% trehalose solar dryer
0.6% trehalose solar dryer
6% trehalose solar dryer
fresh fish fillet
appearance
odor
color
texture

Figure 5

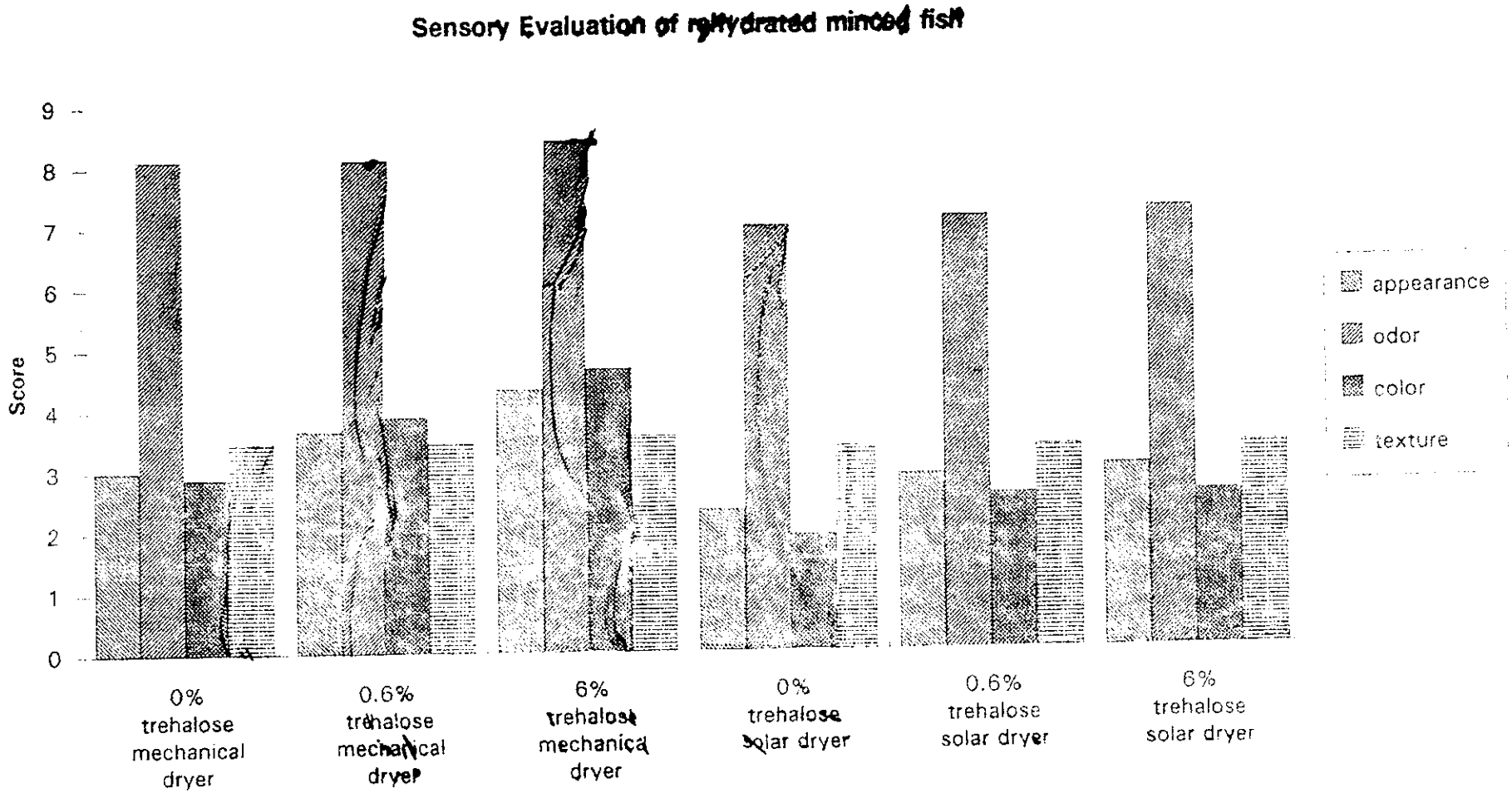
Sensory Evaluation of rehydrated minced fish
Score
9
8
7
6
5
4
3
2
1
0
0% trehalose mechanical dryer
0.6% trehalose mechanical dryer
6% trehalose mechanical dryer
0% trehalose solar dryer
0.6% trehalose solar dryer
6% trehalose solar dryer
appearance
odor
color
texture

Figure 6

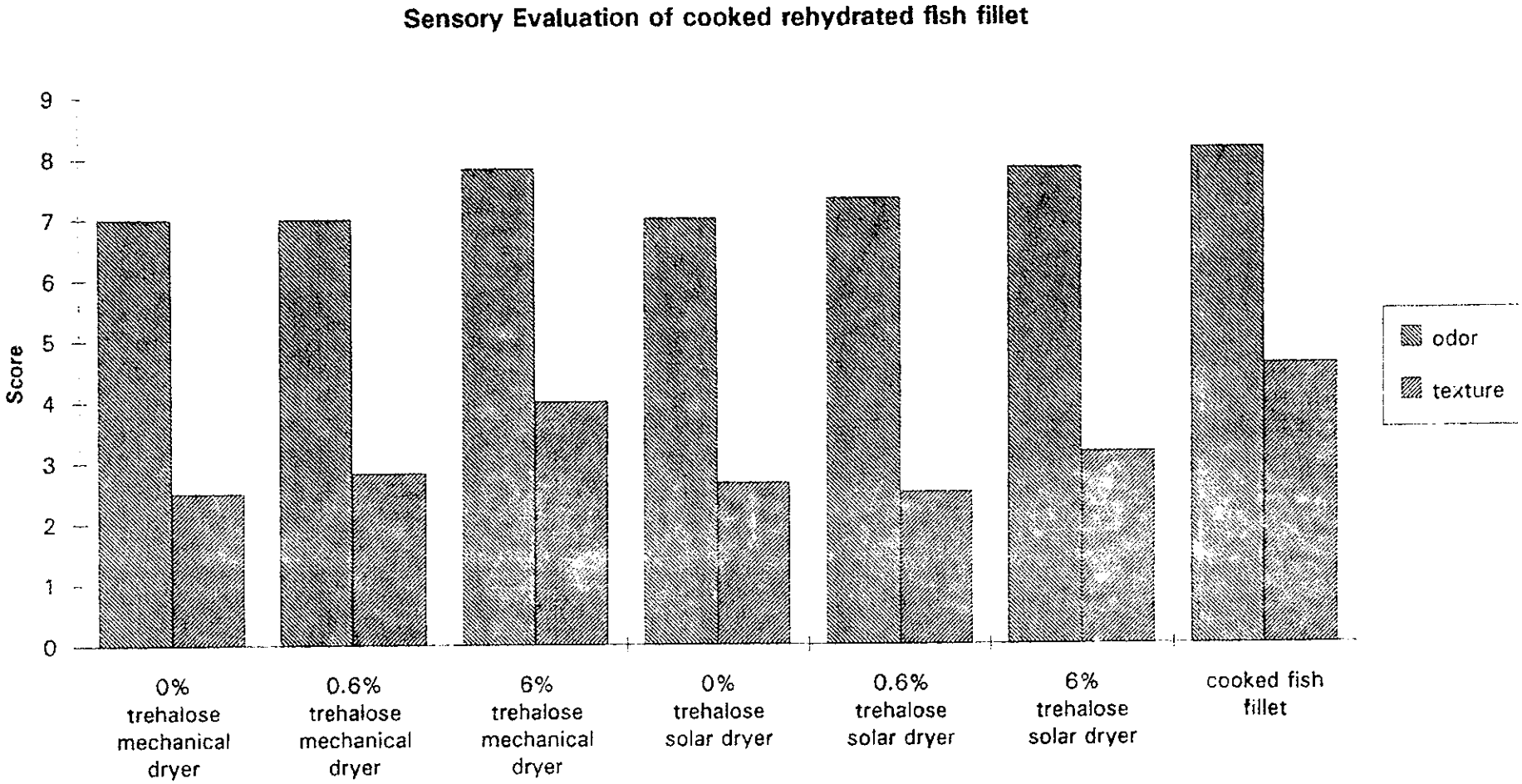
Sensory Evaluation of cooked rehydrated fish fillet
Score
9
8
7
6
5
4
3
2
1
0
odor
texture
0% trehalose mechanical dryer
0.6% trehalose mechanical dryer
6% trehalose mechanical dryer
0% trehalose solar dryer
0.6% trehalose solar dryer
6% trehalose solar dryer
cooked fish fillet

Figure 7

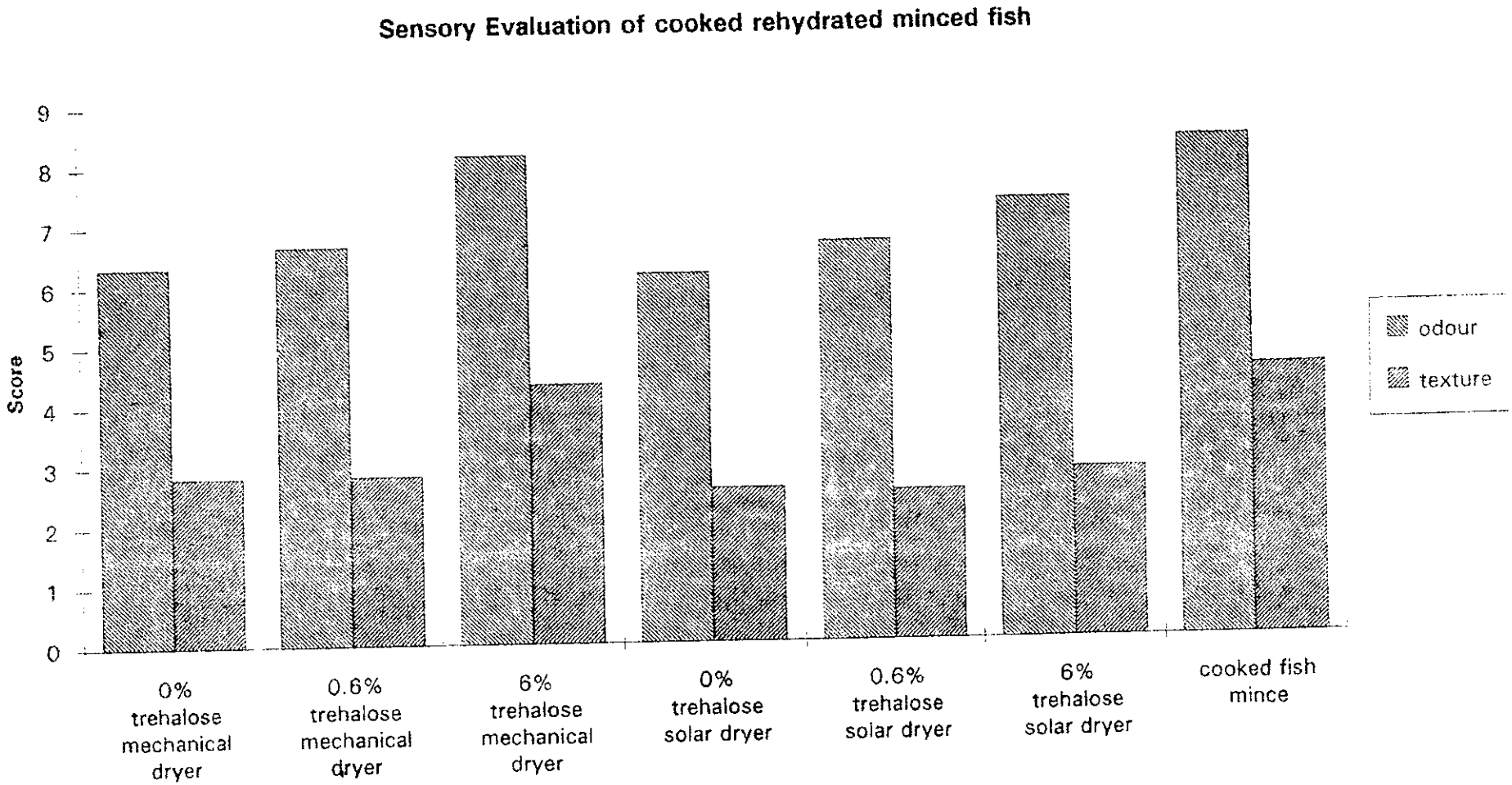
Sensory Evaluation of cooked rehydrated minced fish
Score
9
8
7
6
5
4
3
2
1
0
odour
texture
0% trehalose mechanical dryer
0.6% trehalose mechanical dryer
6% trehalose mechanical dryer
0% trehalose solar dryer
0.6% trehalose solar dryer
6% trehalose solar dryer
cooked fish mince

Figure 8

ANNEX 1

Score Sheet for Evaluation of Dried Fish

Date:..... Name:.....

Examine each sample for appearance, odour, colour and texture and give a score according to the description at the bottom of this sheet

No of Sample	Score			
	Appearance	Odours	Colour	Texture

Description Score

Appearance	Score
Translucent flesh	5
Waxy appearance	3
Some opacity	2
Opaque flesh	0
Odours	
Fresh seaweedy odours	10
Loss of fresh seaweediness	9
No odours, neutral odours	8
Slightly musty, mousy, milky	7
Bready, malty, beery, yeasty odours	6
Latic acid, sour milk or oily odours	5
Fruity or chloroform-like odours	4

Odours	Score
Matches, phosphine like odours	3
Ammoniacal odours	2
Hydrogen sulphide	1
Indole, putrid odours	0
Texture	
Firm, elastic to finger touch	5
Softening of the flesh	3
Softer flesh	2
Very soft	1
Colour	
White	5
Slightly yellow	3
Yellow	1

ANNEX 2

SENSORY EVALUATION OF COOKED FISH

NAME: ..... **DATE:** .....

Odour	Score	Sample Code									
Strong seaweedy odours	10										
Loss of some seaweediness	9										
Lack of odour or neutral odours	8										
Slight strengthening of the odour but no sour or stale odour; wood shavings, woodsap, vanillin or terpene-like odours	7										
Condensed milk, caramel or toffee-like odours	6										
Milk jug odours, or boiled potato or boiled clothes-like odours	5										
Lactic acid and sour milk, or "byre-like" odours	4										
Lower fatty acids (for example, acetic or butyric acids) some grassiness or soapiness, turnipy or tallowy odours	3										
Ammoniacal (trimethylamine) and some sulphide odours	2										
Strong ammoniacal (trimethylamine) and some sulphide odours	1										
Strong ammonia and faecal, indole and putrid odours	0										

Texture	Score	Sample Code									
Firm thick-white curd, bluish white in appearance, no discolouration	5										
Firm but woolly, lost its bluish whiteness, some yellowing	3										
Softer, cheesy-like, marked discolouration	2										
Sloppy, soapy, very marked browning	1										