MINISTERIE VAN LANDBOUW
BESTUUR VOOR LANDBOUWKUNDIG ONDERZOEK
KOMMISSIE VOOR TOEGEPAST WETENSCHAPPELIJK ONDERZOEK
IN DE ZEEVISSERIJ (T. W. O. Z.)

(Voorzitter: F. LIEVENS, directeur-generaal)

ORGANOLEPTICAL, CHEMICAL AND MICROBIOLOGICAL ASPECTS OF VACUUM PACKED AND UNPACKED SMOKED PINK SALMON

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ONDERWERKGROEP
„VISVERWERKENDE BEDRIJVEN - VOORVERPAKKING VIS" (I.W.O.N.L.)

Mededelingen van het Rijksstation voor Zeevisserij (C. L. O. Gent)
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Introduction.

The retail food market is changing rapidly ; the number of shops handling a narrow range of foods is decreasing, while super-markets and large self-service stores are increasing in number and size. A considerable scope for expanding the market for fish through these modern outlets exists provided a good quality product is attractively presented for sale in a suitable package.

Packaged fish products can be easely handled, examined by the customer for type, quantity and price, purchased and carried home in the shopping basket to gether with other foods.

Unpacked fish on the contrary has a number of disadvantages. The products are inconvenient to handle and there may be some smell and possibly contamination.

Pre-packing is mainly a method of presentation not of preservation. In this work the effect of vacuum packing on the quality of smoked pink salmon was studied.

1. Materials and Methods.

1.1. Technological process.

A batch of twenty frozen salmon (Salmo salar L.) of an average weight of 3 kg was used for the experiment.

After thawing at 2°C, the fish were filleted and the bones removed. Dry salting was carried out with 6 % salt, the exudation being drained off. The filleted salmon was washed and dried in an experimental dryer during 6 hours. The air velocity was 3 m/sec, the temperature 22°C and the relative humidity 78 %. After drying, the filets were smoked for two hours in a "Torry Kiln". Half of the smoked salmon was vacuum packed, the other half being left unpacked. Unpacked and packed smoked salmon were stored in a cold store maintained at 2°C.

During conservation the quality of the packed as well as of the unpacked smoked salmon was examined at regular intervals by means of organoleptical, chemical and bacteriological methods.

1.2. Methods.

- Fat content : the method of Bligh and Dyer (1).
- Dry matter and salt : by the methods of the AOAC (2).
- Total volatile acids (TVA) : according to the AOAC method (2).
- Total volatile bases (TVN) : by the method of Lücke and Geidel (3) as modified by Antonacopoulos (4).
- Thiobarbituric acid (TBA) : determined by the method of Tarladgis et al. (5), but using Antonacopoulos' still (6).

- Ammonia : by accelerated microdiffusion (7).
- Microbiological assessments : the total numbers of Enterobacteriaceae, Vibrio, Staphylococcus, yeasts and moulds by the methods described by Mossel and Tamminga (8).

  Gram negative rods according to Shewan's schema (9) and the gram positive rods according to the scheme Kazanas (10).

2. Results and discussion.

2.1. Dry matter, fat and salt contents.

Dry matter, fat and salt contents are given in table 1.

Table 1 - Dry matter, fat and salt contents of the frozen and smoked product in %.

Salmon	Dry matter %	Fat %	Salt %
Frozen	35	12,1	0,9
Smoked	42,7	15,2	1,2

The total weight loss after salting, drying and smoking of the filleted salmon was 19 %.

2.2. Organoleptical assessment.

Organoleptical judgment (figure 1) showed that during the first 10 days vacuum packing had no influence on the shelf life of smoked salmon. Between the 10th and 14th day, a great change in quality of the vacuum packed salmon was noted. The smoked

salmon became viscous and the colour of the fish flesh pale. The same defects were noted for the unpacked smoked salmon but to a lesser extent.

After 18 days of storage moulds appeared on the unpacked smoked salmon. The organoleptic judgment was then interrupted.

Organoleptical assessments showed that vacuum packed and unpacked salmon were respectively 12 $\pm$ 1 and 13 $\pm$ 1 days of an excellent quality. The two batches were considered to be at the borderline of acceptability after 3 weeks.

2.3. Chemical results.

Figure 2 shows the chemical results on smoked vacuum packed and unpacked salmon during storage at 2°C. The analyses were interrupted after 35 days. Total volatile bases (TVN) and ammonia regularly increased and showed in both cases (packed and unpacked) the same pattern of contamination. Changes in the thiobarbituric acid content were small for vacuum packed salmon, but very important for the unpacked salmon after 14 days. Between the 7th and 14th day of storage, a high increase of volatile acids for the vacuum packed salmon was noted. This probably explains the organoleptical changes in flavour and colour of smoked packed salmon. The evolution of pH (figure 1) was constant during the first 10 days of storage. After this period pH increased regularly.

2.4. Microbiological results.

Total bacterial counts decreased as a result of the smoking and drying process (figure 3).

During the first 20 days of storage total counts increased slowly corresponding to increasing TVN and NH_3 contents. After 21 days, bacterial counts rose quickly. For packed as well as for unpacked smoked salmon, the bacterial count was of the same range. With regard to the growth of the anaerobic bacteria in unpacked salmon, a decrease was noted at the end of the storage period. Growth of yeasts and moulds was noted after 14 days of storage. This was in good agreement with the organoleptical scores. Unpacked smoked salmon was rejected as a result of mould colonies appearing after 18 days of storage.

The evolution of the total counts of Enterobacteriaceae was the same in both cases (21 % to 28 % of the total bacterial counts).

The numbers of gram negative rods determined in vacuum packed and unpacked salmon during storage at 2°C are shown in tables 2 and 3.

Biodeterioration at low temperatures is accompanied by a marked increase in the numbers of gram negative rods of the Achromobacter types irrespective of the initial flora. Flavobacterium was found in frozen as well as in smoked salmon. During storage their absolute numbers decreased in both cases and desappeared completely after 14 days. The genus Vibrio was absent in the frozen salmon, but present in the smoked samples. The presence of Vibrio in the smoked salmon must be seen as a secondary contamination during processing. Vibrio species only disappear in the unpacked salmon after 14 days.

Alcaligenes types were not present during the first fourteen days. At the end of the storage period the numbers of Achromobacter and Alcaligenes types were the same for the unpacked as well as for the packed smoked salmon. Pigmented (group I) and non-pigmented (group II) Pseudomonas were found in the initial flora.

Table 2 - Numbers of gram negative rods determined in vacuum packed smoked salmon during storage at 2°C. The numbers are expressed in % and in log/g fish flesh.

Storage in days	Entero-bacteriaceae	Flavo bacterium	Achro-mobacter	Alcaligenes	Vibrio	Pseudomonas		
						Pseudomonas fluorescens (I)	Pseudomonas aëruginosa (I)	Pseudomonas (II)
Frozen	8 %	61 %	10 %	-	-	8 %	-	5 %
log/g	2.45	3.34	2.55			2.45		2.25
Smoked	23 %	23 %	6 %	-	12 %	-	-	12 %
log/g	2.3	2.3	1.7		2.02			2.02
7 days	28 %	-	18 %	-	9 %	-	-	9 %
log/g	2.28		2.19		1.89			1.89
14 days	25 %	-	25 %	17 %	17 %	-	-	-
log/g	3.33		3.33	3.18	3.18			
21 days	36 %	-	24 %	19 %	13 %	-	-	-
log/g	4.33		4.05	3.95	3.79			
35 days	28 %	-	24 %	21 %	16 %	-	5 %	-
log/g	5.61		5.56	5.49	5.37		4.86	

Table 3 - Numbers of gram negative rods determined in unpacked smoked salmon during storage at 2°C. The numbers are expressed in % and in log/g fish flesh.

Storage in days	Entero-bacteria-ceae	Flavo bacterium	Achromo-bacter	Alcali-genes	Vibrio	Pseudomonas fluorescens (I)
7 days	25 %	10 %	12 %	-	14 %	14 %
log/g	2.60	2.08	2.27		2.34	2.34
14 days	27 %	-	13 %	-	21 %	14 %
log/g	3.55		3.28		3.44	3.57
21 days	37 %	-	25 %	13 %	-	-
log/g	3.9		3.75	3.44		
35 days	21 %	-	12 %	12 %	-	15 %
log/g	4.9		4.66	4.66		4.75

Table 4 - Numbers of gram positive bacteria determined in vacuum packed and unpacked salmon during storage at 2°C. The numbers are expressed in % and in log/g fish flesh.

Storage in days	Pediococcus	Sarcina	Brevi-bacterium	Staphylo-coccus
Frozen	-	-	4 % (1.15)	4 % (1.15)
Smoked	-	-	-	24 % (2.31)
7 vacuum	-	-	9 % (1.89)	27 % (2.37)
unpacked	-	-	-	25 % (2.60)
14 vacuum	-	8 % (2.85)	-	8 % (2.85)
unpacked	-	-	-	25 % (3.52)
21 vacuum	-	-	-	8 % (3.57)
unpacked	-	-	-	25 % (3.73)
35 vacuum	-	-	-	6 % (4.95)
unpacked	15 % (4.75)	-	-	25 % (4.98)

In the unpacked smoked salmon Pseudomonas fluorescens was always observed during storage, whereas they disappeared in the vacuum packed salmon.

The numbers of gram positive rods determined in vacuum packed and unpacked salmon during storage are shown in table 4.

An important increase of Staphylococcus spp due to secondary contamination, during processing was noted. During storage only a percentage decrease was noted for the facuum packed salmon.

ACKNOWLEDGMENT.

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Literature.

1. Bligh, E. & Dyer, W., Can. J. Biochem. Physiol., 37. 911 (1959).
2. Methods of the AOAC; AOAC, Washington, 11th Ed. (1970).
3. Lücke, W. & Geidel, Zeitschr. Lebensm.-Unters. 70, 441 (1935).
4. Antonacopoulos, N., Lehrbuch der Lebensmittelchemie, Vol. III/2, Springer Verlag, Berlin (1968).
5. Tarladgis, B., Watts, B. & Jonnathan, M., J. Amer. Oil Chem. Soc., 37, 44 (1960).
6. Antonacopoulos, N., Zeitschr. Lebensm.-Untersuch. u. Forsch., 113, 113 (1960).
7. Vyncke, W., Fish. News Int., 7, 49 (1968).
8. Mossel, D.A.A. and Tamminga, S.K., Methoden voor het microbiologisch onderzoek van levensmiddelen. P.C. Noordevliet, Zeist (1973).
9. Shewan, J.M., Hodgkiss, W. and Hobbs, G., J. Appl. Bact., 23, 379 (1960).
10. Kazanas, N., Applied Microbiol., 14(6), 957 (1966).

FIG 1 – EVOLUTION OF ORGANOLEPTIC SCORE AND PH DURING STORAGE OF VACUUM PACKED AND UNPACKED SMOKED SALMON AT 2°C.

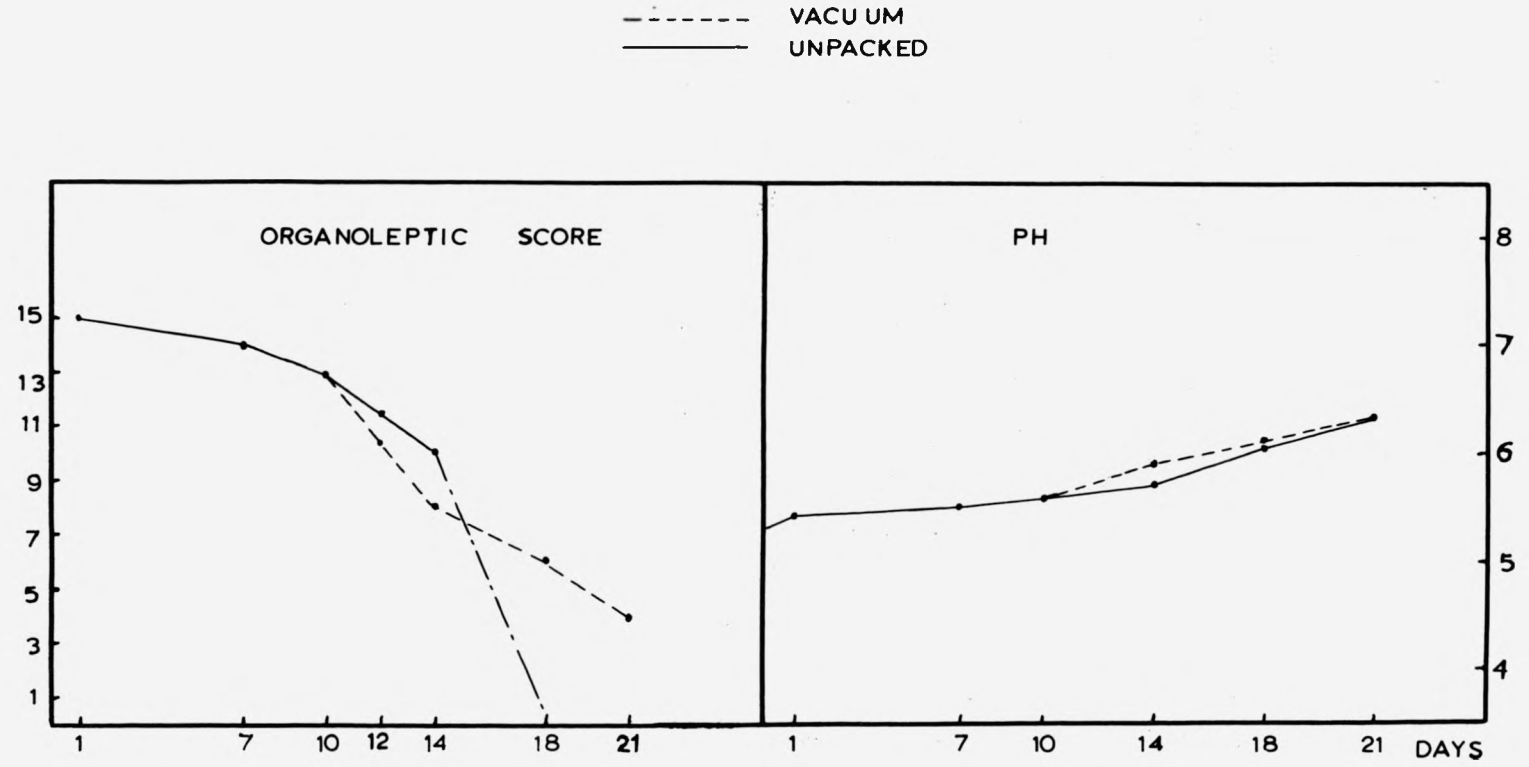

FIG 2- EVOLUTION OF TVN, NH_3, TBA AND VOLATILE ACIDS DURING STORAGE OF VACUUM PACKED AND UNPACKED SALMON AT 2°C.

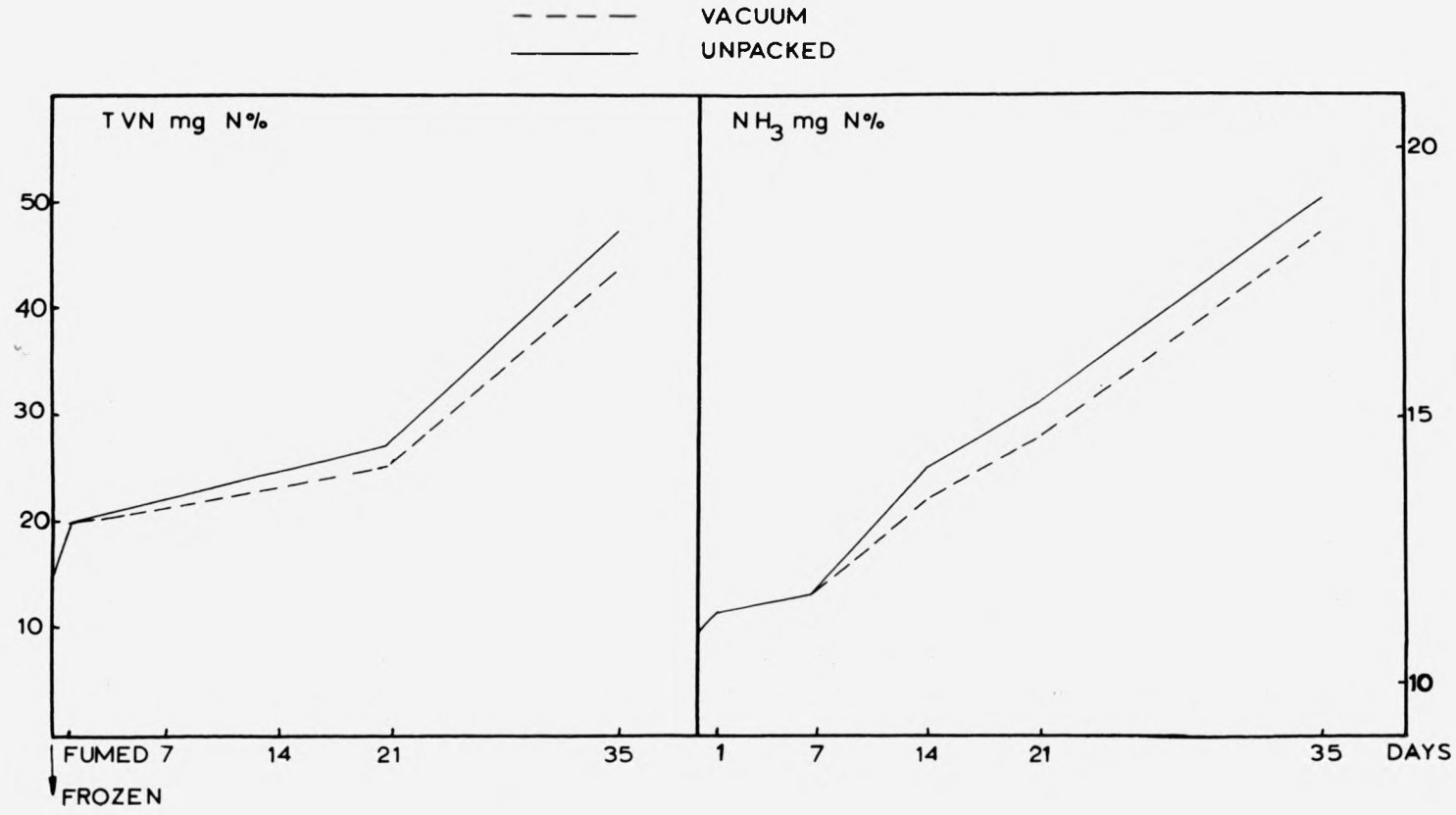

FIG 2 - (CONTINUED)

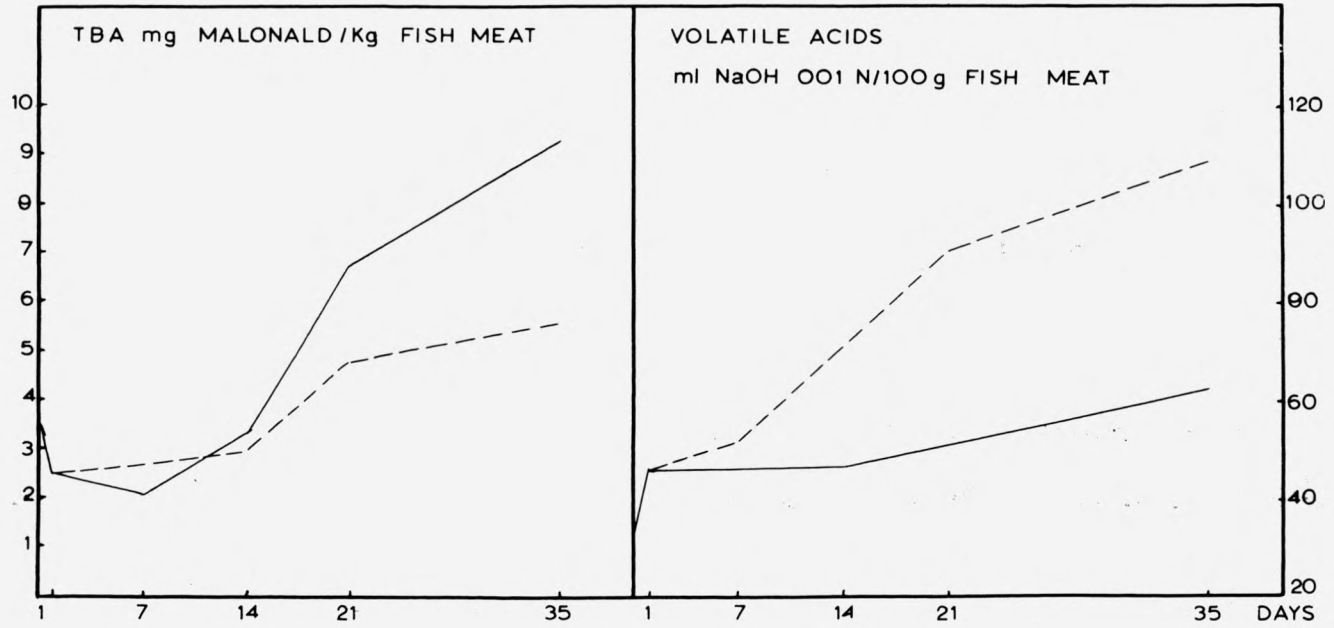

FIG 3 - EVOLUTION OF THE TOTAL COUNT OF BACTERIA, ANAEROBIC BACTERIA, YEASTS AND MOULDS DURING STORAGE AT 2°C OF VACUUM PACKED AND UNPACKED SMOKED SALMON.

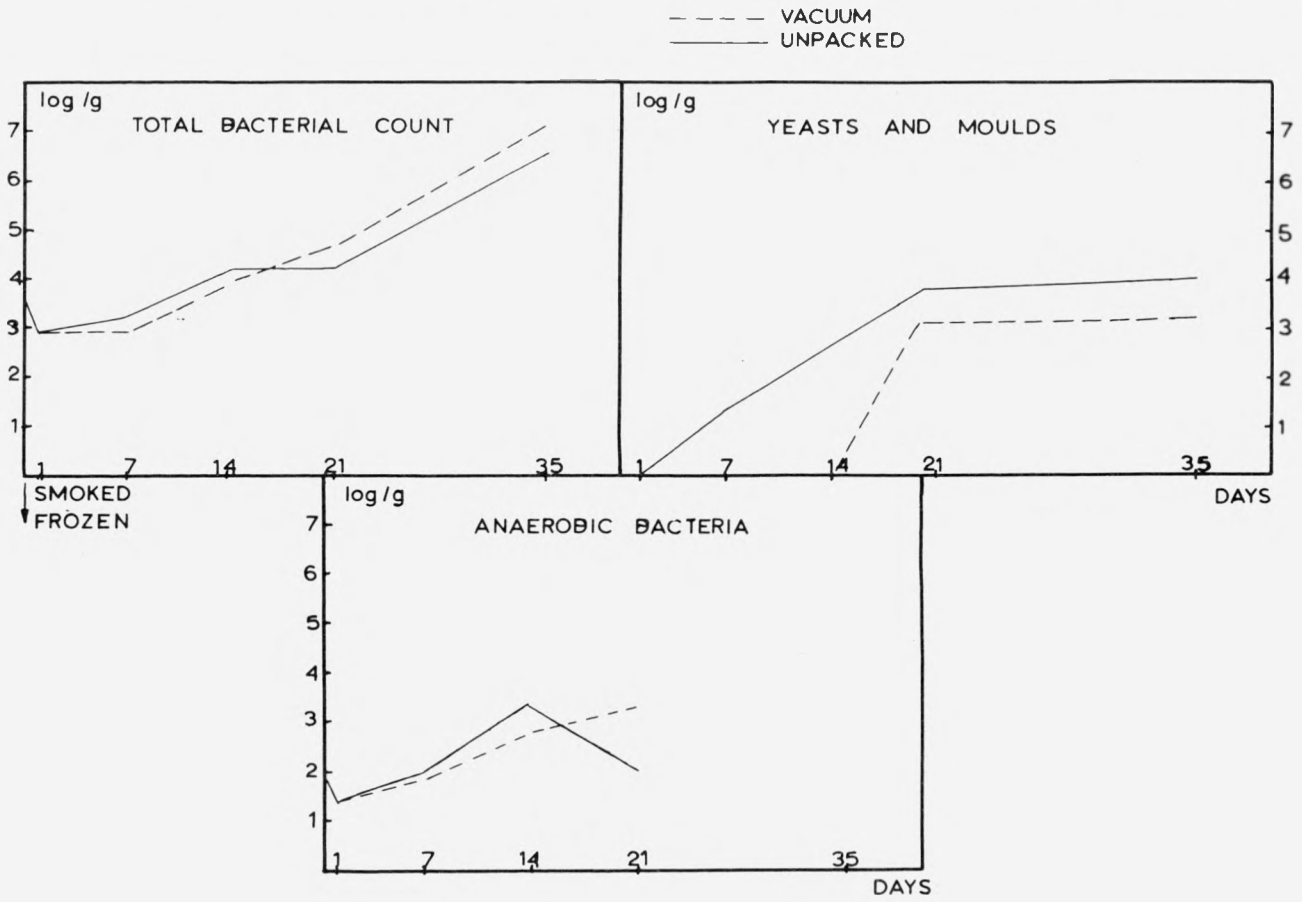

FIG 3-(CONTINUED)