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KOMMISSIE VOOR TOEGEPAST WETENSCHAPPELIJK ONDERZOEK
IN DE ZEEVISSERIJ (T. W. O. Z.)

(Voorzitter: F. LIEVENS, directeur-generaal)

CANNED MANGROVE CRAB (SCYLLA SERRATA) : A PRODUCT WITH LIMITED SHELF LIFE

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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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Paper presented at the Sixth Meeting of W. E. F. T. A.,
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INTRODUCTION.

Mangrove crab meat (Scylla serrata) of Malaysian origin presented especially at the beginning certain processing and storage problems for the Belgian canning industry.

In this context the quality of the raw material as well as that of the canned product was examined. The autoclaved cans were stored during four months at -18°, +5°, +20°, +35° and + 50° C.

In order to clear up some difficulties in the interpretation of the results, a second series of experiments was carried out to follow microbial development at the beginning of storage at 50° C.

For each series the quality of the product was determined. A number of tests was also carried out to ascertain the microbiological safety of the product.

1. Materials and Methods.

1.1. Technological procedure.

The crab meat used for canning was frozen and packed in plastic film on arrival in the processing plant.

After thawing at 10° C, 275 ml cans were filled with crab meat and 60 ml liquid was added.

The liquid contained salt, acids and some sweetener. After filling, commercial sterilization was carried out for 70 to 80 minutes at 110° C.

At the end of the heating process chlorinated cool water was gradually introduced into the retort and overpressure was reduced slowly as the product was cooled.

For the experiment 100 cans were used and treated as follows :

- 20 cans were kept for 4 months in freezer (-18° C)
- 10 cans were kept for 2 months in refrigerator (+5° C)
- 10 cans were kept for 4 months in refrigerator (+5° C)
- 10 cans were kept for 2 months at 20° C
- 10 cans were kept for 4 months at 20° C
- 10 cans were kept for 2 months at 35° C
- 10 cans were kept for 4 months at 35° C
- 10 cans were kept for 2 months at 50° C
- 10 cans were kept for 4 months at 50° C

1.2. Methods.

- Dry matter and salt : by the methods of the AOAC (1).
- Total volatile acids (VAN) : by the method of the AOAC (2) but using Antonacopoulos' still (3) ; 500 ml were distilled over.
- Total volatile bases (TVN) : by the method of Lucke and Geidel (4) as modified by Antonacopoulos (5).
- Ammonia : by accelerated microdiffusion (6).
- Microbiological assessments : Total aerobic, anaerobic bacterial counts were made by inoculation in Petri dishes containing Plate Count Agar. The GasPak anaerobic system (BBC, Cockeysville, Maryland, USA) was used for anaerobic counts. Incubations lasted for 72 hrs at 30° C.

  Safety tests were carried out with detection reactions described by Mossel and Taminga (7) for Enterobacteriaceae, Coliforms, Salmonellae, Vibrio paraheamolyticus and Staphylococcus aureus.

  The enrichment and isolation media for the detection of Bacillaceae was realised with "Brain heart infusion" + 2 gr soluble starels and "Peptone lactose yeast extract agar" with additional starch and brown cresol purple (Iatrea).

  The media of Rosenow (Iatrea) and "Glucose yeart-beef extract agar" (Iatrea) with additional horse blood were used for the isolation of Clostridium. Further determination such as amylase activity, H_2S

production, indole formation, reduction of nitrate and fermentation reactions were carried out.

- Organoleptic judgment : was performed by a panel of four members on odour, texture, colour, taste, gas, liquid, blackening and swelling.

2. Results and discussion.

2.1. Dry matter and salt content.

Table 1 - Dry matter and salt content of the raw material and canned crab meat in %

Crab	Dry matter %	Salt content %
Frozen	14	0.56
Canned	13.1	1.1

Only 13.1 percent dry matter in the canned product was noted. This dry matter content is very low and is typical for the product examined.

2.2. Organoleptic assessment.

The results of the organoleptical judgments (tables 2 and 3) showed that there is no change in the cans stored for 2 and 4 months at -18° and + 5° C.

As regards the cans stored at 20° C, ten percent changed in odour and flavour after two months' storage. Definitive changes in flavour and odour were noted after four months : the canned crab reached almost the limit of acceptability.

The cans kept at 35° and 50° C were already of bad quality after two months' storage. Swelling was only observed in the cans stored at 50° C.

2.3. Chemical results.

The results of the pH, NH_3, TMA, TVN and VAN determinations (tables 4, 5, 6, 7, 8) carried out after 2 and 4 months confirmed the organoleptic judgments.

The NH_3, TMA, TVN content increased after the canning process : in the raw material 6.9 mg N %, 1.05 mg N % and 11.1 mg N % were noted respectively. After canning 12.3 mg N %, 3.8 mg N % and 25 mg N % were attained.

The content of VAN on the contrary decreased after processing. This phenomenon is due to the fact that heated cans were closed only at the end of the process.

A decrease of pH values (table 4) was noted only in the cans stored at 35° and 50° C.

A high increase of ammonia, total volatile bases and volatile acids content (table 5, 7 and 8) was noted for the cans stored at 50° C. In mesophilic conditions, ammonia, TVN and VAN production was smaller.

Considering the two storage periods (2 and 4 months) no great differences in NH_3, TVN and VAN content could be noted for cans stored at 50° C. For this incubation temperature alteration occurred early during the storage period and progressed very slowly afterwards.

Determinations of TMA content (table 6) gave no information as to the quality of canned crab. TMA content of all examined cans was rather low. An additional experiment showed that all TMAO was converted into TMA after two months of storage. This proves that some microbiological activity was present.

In general alteration products were very high in cans stored under thermophilic conditions (50° C) ; however these were smaller but still very important, under mesophilic conditions (35° C).

2.4. Microbiological results.

Total aerobic and anaerobic bacterial counts were generally zero for all incubated cans.

Aerobic micro-orgnisms werd counted only in the cans incubated at 20° C.

This indicates that the spores did not develop in the cans incubated at 5° C, and that the micro-organisms developed and later died in the cans kept at 50° C.

This phenomenon was cleared up during an additional series of experiments carried out to follow microbiological development at the beginning of storage of the cans stored at 50° C.

Commercial sterilised crab meat was put acceptically in an erlermeyer. The erlemeyer was placed in an anaerobic jar and incubated at 50° C.

Every four hours a sample was examed for pH, NH_3, TMA, TVN, VAN, aerobic and anaerobic development.

pH values decreased after 160 hours.

Formation of NH_3, TVN and VAN increased gradually. TM A formation reached its maximum after 36 hours. This was in full agreement with the results of the first experiment (table 9).

At the beginning of the incubation period no bacteria were counted (table 10). After 20 hours, growth of aerobic as well as anaerobic bacteria was detected. The maximum number of anaerobic and aerobic bacteria was counted after 28 hours. At the end of the incubation period (160 hours) no bacteria were detected in the crab meat.

All the tests performed to determine the safety of the canned product were negative. It could thus be concluded that the crab was canned under adequate hygienic conditions.

Table 11 gives the results of the numbers of cans positive for Bacillus and Clostridium.

Identification tests on the isolated colonies indicated Clostridium sporogenes (table 12). Further identification tests on Bacillus were not performed.

The general conclusion of these tests was that Mangrove crab canned in the conditions described here has a limited shelf life at 20° C and should be kept cool .

Further investigations are necessary to establish the optimal storage temperature.

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Table 2 : Organoleptic assessment of canned crab after two months' storage at different temperatures.

Storage temperature	Odour	Colour	Flavour	Consistence	Gas ml	Liquid ml	Blackening	Swelling
-18 °C and +5 °C	no change	no change	no change	no change	3.5	60	no blackening	none
+20 °C	off-odours (1 : 10)	no change	off-flavours (1 : 10)	no change	3.5	60	no blackening	none
+35 °C	off-odours (10 : 10)	some darkness	off-flavours (10 : 10)	decreased	——	96	no blackening	none
+50 °C	putric odours (10 : 10)	definitely dark	putric flavours (10 : 10)	decomposed	pressure when opening cans	112	blackening	swelled

Table 3 : Organoleptic assessment of canned crab after four months' storage at different temperatures.

Storage temperature	Odour	Colour	Flavour	Consistence	Gas ml	Liquid ml	Blackening	Swelling
_18 °C and + 5°C	no change	no change	no change	no change	3.5	60	no blackening	none
+ 20 °C	some off_odours (10:10)	no change	some off_flavours (10:10)	no change	3.5	60	no blackening	none
+ 35 °C	off_odours (10 10)	some darkness	off_flavours (10 10)	decreased	____	97	no blackening	none
+ 50 °C	putric odours (10:10)	definitely dark	putric flavours (10:10)	decomposed	pressure when opening cans	118	blackening	swelled

Table 4 : Evolution of mean value of pH of the two and four months stored cans at different temperatures.

Storage time in months	Storage temperatures				
	- 18 °C	+5 °C	+ 20 °C	+ 35 °C	+ 50 °C
2	6.9	6.9	6.9	6.6	6.3
4	6.9	6.9	6.8	6.4	6.2

Table 5 : Evolution of mean value of NH_3 content (mg N%) of the two and four months stored cans at different temperatures.

Storage time in months	Storage temperatures				
	- 18 °C	+ 5 °C	+ 20 °C	+ 35 °C	+ 50 °C
2	12.3	11.7	13.1	14.8	41.3
4	12.3	12	13.6	18.1	45.6

Table 6 : Evolution of mean value of TMA content (mg N%) of the two and four months stored cans at different temperatures.

Storage time in months	Storage temperatures				
	- 18 °C	+ 5 °C	+ 20 °C	+ 35 °C	+ 50 °C
2	3.8	7.9	11.5	11.8	11.1
4	3.8	5.4	11.5	13.8	10.9

Table 7 : Evolution of mean value of TVN content (mg N%) of the two and four months stored cans at different temperatures.

Storage time in months	Storage temperatures				
	- 18 °C	+ 5 °C	+ 20 °C	+ 35 °C	+ 50 °C
2	25.2	26	26.7	30.7	59.6
4	25.2	25.4	29,8	36.6	63.6

Table 8 : Evolution of mean value of VAN content (ml NaOH 0,01 N per 100 g meat) of the two and four months stored cans at different temperatures.

Storage time in months	Storage temperatures				
	- 18 °C	+ 5 °C	+ 20 °C	+ 35 °C	+ 50 °C
2	12.5	16.5	16.8	29.5	151.2
4	12.5	16.6	16.1	29.6	179.3

Table 9 : Evolution of chemical results of crab meat during anaerobic storage at 50 °C.

Hours	pH	NH_3 mg N°/o	TMA mg N°/o	TVN mg N°/o	VAN ml NaOH 0.01N/100g meat
0	7.1	11.20	7.66	24.08	21.6
4	7.1	13.08	8.28	25.06	24.0
12	7.0	15.32	8.90	25.34	26.4
20	7.1	15.90	9.96	25.88	30.0
28	7.0	16.12	10.35	26.88	38.4
36	7.1	16.96	10.59	27.86	42.0
44	7.0	17.15	10.66	29.68	46.0
52	6.8	18.29	10.55	32.20	56.4
60	6.9	21.78	9.18	32.62	61.2
160	6.2	22.8	9.20	33.80	66.3

Table 10: Evolution of total aerobic and anaerobic counts of crab meat during storage at 50°C.

Hours	Aerobic Counts	Anaerobic Counts
0	0	0
20	30000	1600
28	35000	35000
44	30000	1520
52	10500	0
160	0	0

Table 11 : Number of cans found positive for Bacillus and Clostridium.

Storage time	Conservation temperature in °C				
	-18	+ 5	+ 10	+ 35	+ 50
2	—	—	8 : 10	8 : 10	6:10 (4:10 [x])
4	—	—	8 : 10	10 : 10	4:10 (10:10 [x])

[x] Numbers mentioned in brackets are for Clostridium.

Table 12 : Results of biochemical tests on ten different colonies of Clostridium.

Tests	Colonies									
	1	2	3	4	5	6	7	8	9	10
Amylase Activity	–	+	–	–	–	–	–	–	–	–
H_2S Production	+	+	+	+	+	+	+	+	+	+
Indole Production	–	–	–	–	–	–	–	–	–	–
Reduction of Nitrates	+	–	+	+	+	+	–	+	+	+
Fermentation Reactions										
Glucose	+	+	+	–	+	+	–	+	+	+
Lactose	–	–	–	–	–	–	–	–	–	–
Mannitol	–	–	–	–	–	–	–	–	–	–
Saccharose	–	–	–	–	–	–	–	–	–	–