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# BLACK DISCOLOURATION OF FROZEN, COOKED RED CRAB

by

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HALIFAX, N.S.

JANUARY, 1971

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A substantial amount of the red crabs (*Geryon quinquedens*) caught off the East Banks of Nova Scotia are marketed frozen-whole-cooked. The processing consists of cooking the whole crabs in boiling water and freezing them in a blast freezer. Prior to freezing, elastic bands are placed over the legs and carapace to hold the legs close to the body to avoid dismemberment.

During marketing, problems with texture and black discoloration of the flesh were the two major quality defects experienced. Meat with mushy texture originates from soft-shelled crabs, a problem which can easily be rectified by culling. Black discoloration on the other hand, is likely caused by the enzymatic oxidation of polyhydroxyphenyl and aminophenyl compounds in the tissues. This discoloration of the flesh rendered the crabs unmarketable therefore inducing the industry to request assistance to find the reason and cure for the blackening.

The subsequent investigation initiated in this laboratory was designed to assess the effect of undercooking, storage temperatures and glazing on the development of black discoloration. The study was conducted as described below.

A group of 120 live crabs were cooked for 7 minutes in boiling fresh water. Half (60) of the crabs were glazed with commercial acetylated monoglyceride by dipping them into the glazing solution (105°C) for 2 seconds. Thereafter, thirty glazed and 30 unglazed crabs were placed in a constant temperature box set at  $5^{\circ}\text{F} \pm 0.5^{\circ}\text{F}$ . Similarly, 30 glazed and 30 unglazed crabs were put into another box set at  $-15^{\circ}\text{F} \pm 0.5^{\circ}\text{F}$ . A sample of 3 crabs taken randomly was examined periodically from each group for discolouration by a 6-member panel. The assessment was expressed numerically in a 10-point relative scoring system. Accordingly, a score of 0 represents snow white meat and a score of 10 is equivalent to blackboard black discolouration.

Another group of 120 crabs were treated as described above with the exception that the crabs were cooked for 30 rather than 7 minutes in boiling water. Thirty minutes cooking was recommended by the crab processing expert of the Industrial Development Service.

#### Results:

Development of black discolouration of crab meat during a 4 month storage period is illustrated in Table I. Blackening in the meat is also shown in Photos No. 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. During glazing, the quantity of monoglyceride absorbed varied from 3.7 - 4.8% of the crabs' weight.

Discussion:

The monoglyceride glaze did not affect the discolouration of crab meat. Adequate cooking in boiling water (30 mins.) was the most important criteria in the prevention of blackening. Properly cooked crabs did not discolour even after 4 months of storage. The results of this investigation support the earlier speculation that the blackening is caused by enzymatic action and heat is required to inhibit its occurrence. Seven minute cooking time was not sufficient to prevent the development of discolouration, unlike the 30 minute cooking recommended for the purpose. Occurrence of discolouration in commercially processed crabs suggest that either the cooking time was not long enough or the water temperature sufficiently high to render the blackening process inoperative. The cooking water must be circulated to ensure adequate heating throughout the batch and the timing of cooking should commence when the cooking water begins to boil. The determination of minimum theoretical heat process necessary for the prevention of discolouration was not the purpose of this study. The investigation showed that the recommended 30 minutes cooking time in boiling water is sufficient to preclude the occurrence of black discolouration. The rate of discolouration of the undercooked crab (7 minutes) was significantly higher at 5°F storage as compared to the storage at -15°F.

The dehydration of crabs was apparent after 4 months of storage.

Table I: Ratings of Black Discolouration on Frozen, Whole-Cooked, Red Crab Meat During Storage at 5°F and -15°F Temperature

Treatment	Storage Temp. in F°	Cooking Time in Mins.	COLOUR RATINGS OF SAMPLES									Treatment Means
			STORAGE IN WEEKS									
			0	2	3	4	8	11	12	14	16	
No. 1 Glaze: Nil	5	7	0	7.0	7.0	6.8	6.8	6.9	4.5	6.3	7.0	6.5
No. 2 Glazed	5	7	0	5.9	6.4	6.5	7.5	6.8	6.9	6.3	6.5	6.6
No. 3 Glaze: Nil	-15	7	0	3.7	3.1	4.6	4.3	1.3	2.7	4.3	3.8	3.5
No. 4 Glazed	-15	7	0	4.2	1.6	4.8	2.3	1.9	3.7	2.3	4.4	3.2
No. 5 Glaze: Nil	5	30	0	1.5	0.8	2.8	2.0	1.7	1.5	1.4	1.2	1.6
No. 6 Glazed	5	30	0	1.1	1.2	1.8	1.3	1.2	1.1	1.1	1.6	1.3
No. 7 Glaze: Nil	-15	30	0	1.3	0.5	1.8	1.1	1.1	0.9	0.5	1.3	1.1
No. 8 Glazed	-15	30	0	1.6	0.9	1.4	0.6	1.3	1.5	0.8	1.2	1.2

Recommendations:

- (1) Only hard-shelled crabs should be processed to avoid the marketing of crabs with mushy texture.
- (2) Crabs should be boiled in water long enough (30 minutes) to prevent the development of black discolouration.
- (3) Cooked, frozen, whole crabs should be stored at or below -15°F.
- (4) Crabs should be packaged to prevent dehydration during storage.

Acknowledgements:

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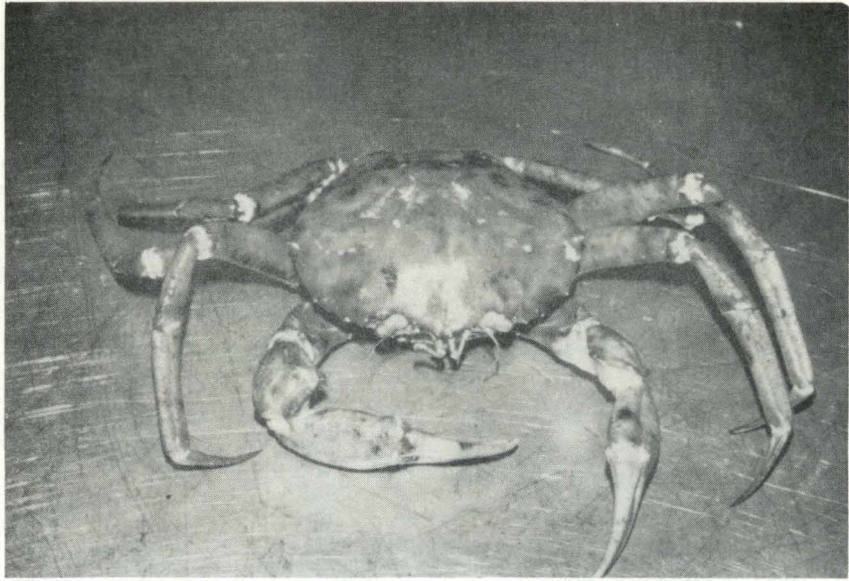


Photo No. 1: Red crab before cooking.

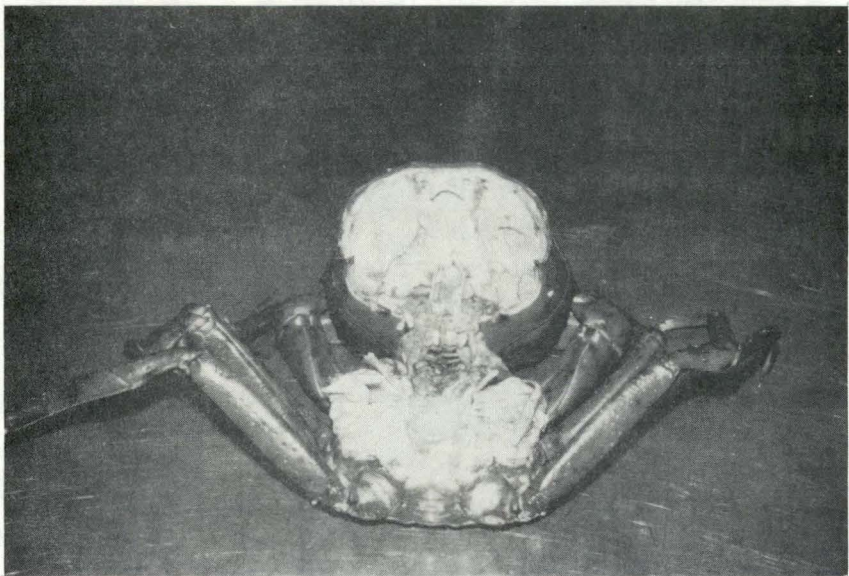


Photo No. 2: Colour of body meat subsequent to cooking in boiling water for 30 minutes.



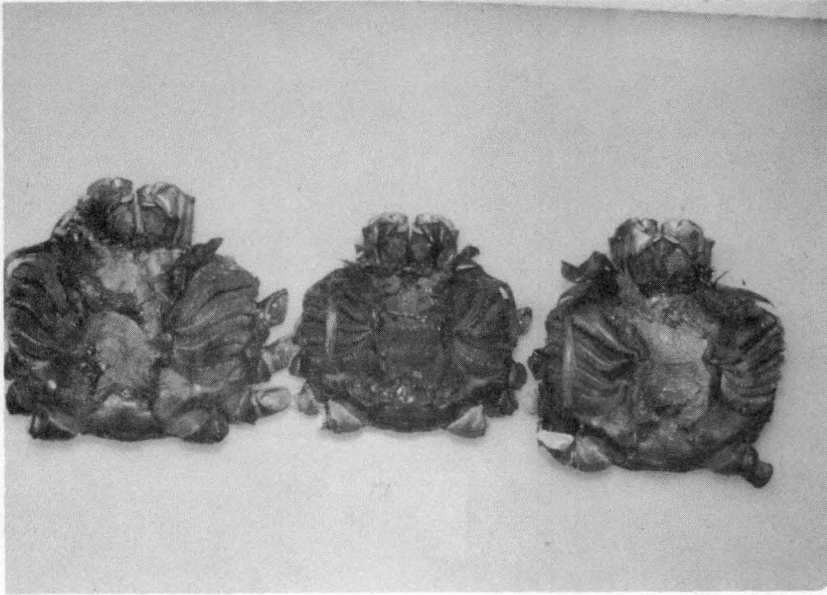


Photo No. 3: Appearance of red crab's tissues after 12 weeks of storage at 5°F. The crabs were cooked for 7 minutes prior to freezing.



Photo No. 4: Appearance of red crab's tissues after 12 weeks of storage at -15°F. The crabs were cooked for 7 minutes prior to freezing.

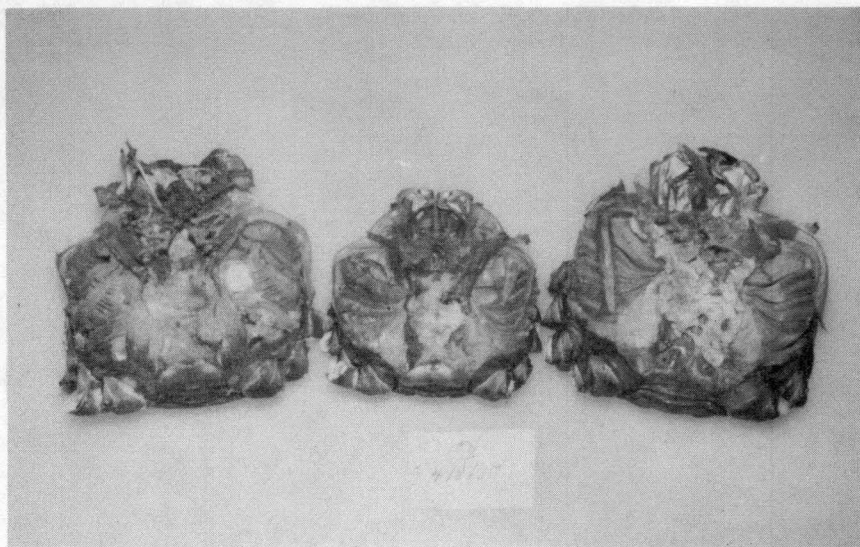


Photo No. 5: Appearance of red crab's tissues after 12 weeks of storage at 5°F. The crabs were cooked for 30 minutes prior to freezing.



Photo No. 6: Appearance of red crab's tissues after 12 weeks of storage at -15°F. The crabs were cooked for 30 minutes prior to freezing.

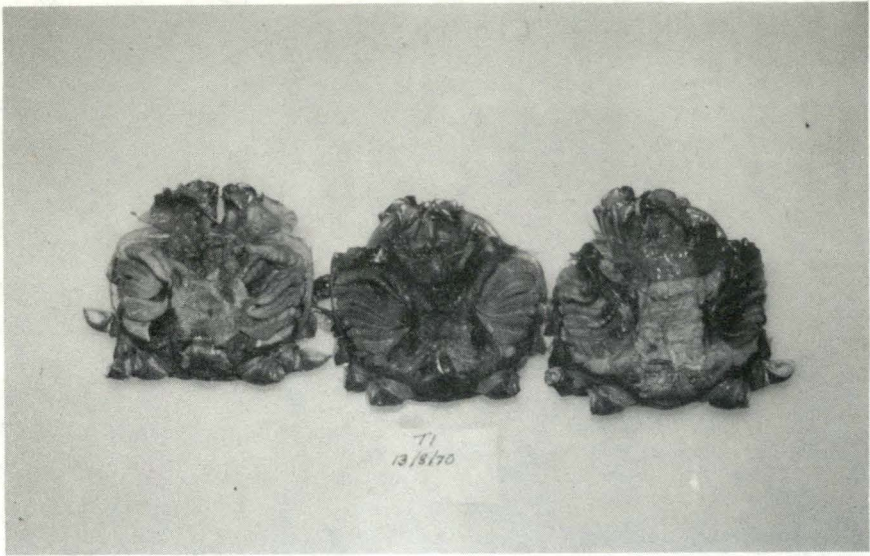


Photo No. 7: Appearance of red crab's tissue after 14 weeks of storage at 5°F. The crabs were cooked for 7 minutes prior to freezing.



Photo No. 8: Appearance of red crab's tissues after 14 weeks of storage at -15°F. The crabs were cooked for 7 minutes prior to freezing.

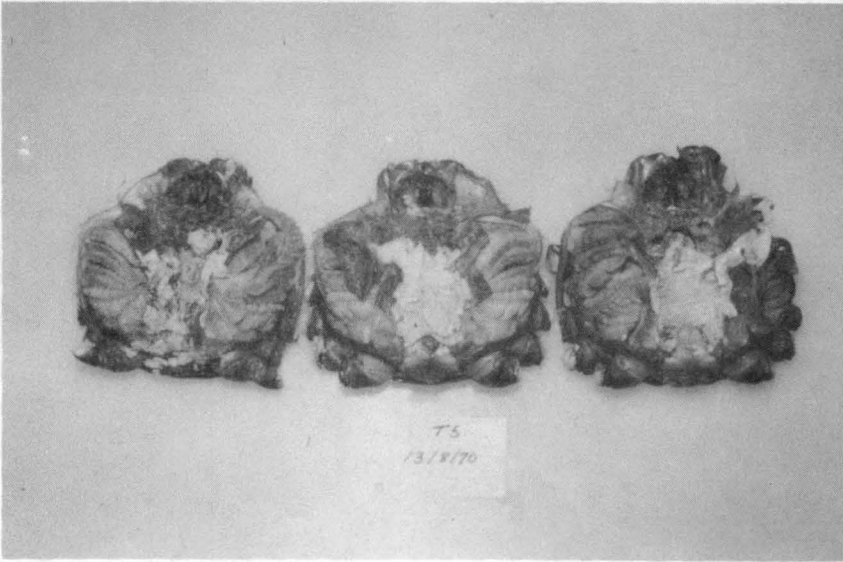


Photo No. 9: Appearance of red crab's tissues after 14 weeks of storage at 5°F. The crabs were cooked for 30 minutes prior to freezing.

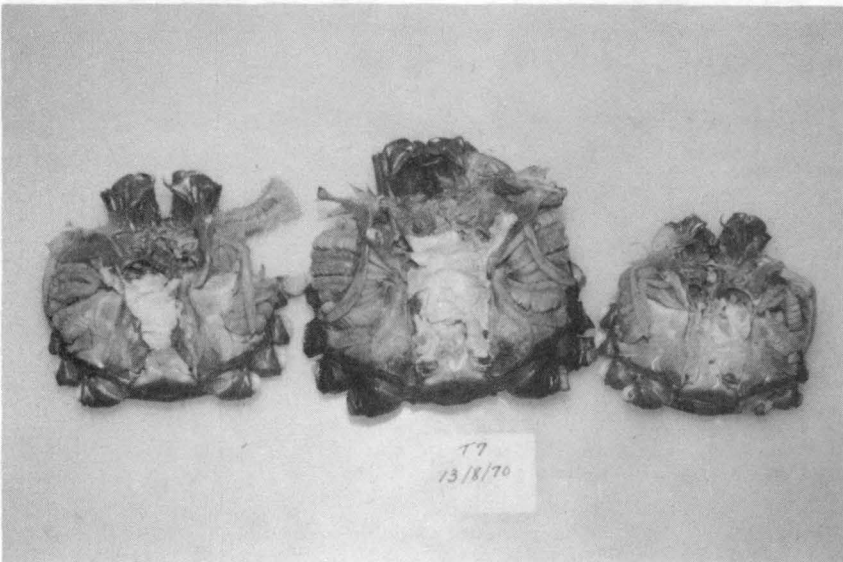


Photo No. 10: Appearance of red crab's tissues after 14 weeks of storage at -15°F. The crabs were cooked for 30 minutes prior to freezing.