The effects of refrigeration on sensory characteristics of oysters (*Ostrea edulis*)

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professional paper

Summary
This study evaluated the sensory characteristics of oyster (Ostrea edulis) samples during refrigeration at the temperatures of 4°C, 7°C and 15°C at several time points (one, three, five, seven, nine and eleven days). The indicators of shellfish quality (the appearance of the shell, the colour of the intervalval fluid, the colour of the edible shellfish part, consistency and smell) were examined and assigned 0 – 3 points. Changes in sensory characteristics of sample oysters stored at 4°C and 7°C occured on the seventh, and of those stored at 15°C on the fifth day.
Key words: *oysters, refrigeration, sensory characteristics*

Introduction

Seafood contains a lot of water and is rich in easily digestible proteins, in carbohydrates and lipids (different from those of mammals in the ratio of saturated and unsaturated fatty acids), vitamins (especially A, E, D and B) and minerals. It also contains selenium, which is a strong antioxidant.

The oyster is stone grey in colour, which makes it difficult to spot on stones in the sea. The fleshy body of the oyster is placed between two shells, valves, surrounded by the intervalval fluid (live, organic fluid, containing various substances and sea water). According to market size, oysters may be divided into three categories: big (longer than 85 mm), medium-sized (70 to 85 mm) and small (up to 70 mm) (Mašić, 2004). The oyster contains vitamins A, B1, B2, C, D, E, PP, and a serving of 15 g of its meat has the same amount of vitamin C as 3 g of lemon juice. Some important essential amino acids (lysine, histidine, tyrosine) are also found in oyster meat. It is abundant in minerals, 100 g of meat containing 50 – 70 mg of calcium, 24 – 48 mg of magnesium, 5 – 9.5 mg of iron. The composition of tissue is not constant but varies, depending on oyster type, breeding area, harvest season, feeding conditions at farms, spawning season, and oyster size. Fattier oysters contain more glycogen. The glycogen level fluctuates during the year, thus changing the quality of the oyster, especially in the spawning season. The smell, the appearance and the taste of oysters vary according to their physiological state and the season in which they are eaten. At the time when they are best for consumption, oysters are called seasonal. In winter they create large quantities of glycogen, which makes them fatty and light in colour and gives a savoury smell and a sweet taste. In late spring and summer they grow thin, tough and dark, due to reproduction. Therefore, the best time to eat oysters is in February, and the caloric value is highest from January to April. The caloric value of 100 g of oyster meat is 80 calories (the same as that of one egg or ¼ l of milk).

Shellfish may however cause various diseases and poisoning. Namely, they feed by filtering sea water, which contains many microorganisms, including pathogenic ones. A shellfish filters 8 l of water per hour, at the same time piling up various microorganisms in its body. It uses some as food and accumulates those which it cannot digest. Accumulated microorganisms are transformed into a vegetative state and remain inactive for a while. Problems occur when a person eats a shellfish that has not been properly thermally processed and contains microorganisms that are pathogenic to humans. The oyster is mostly eaten raw, which makes it potentially dangerous food. Therefore, it should be noted that the pollution of the environment directly causes the pollution of food, in this case, of shellfish, which may endanger the health of end consumers (Čadež and Teskeredžić, 2005; Orait

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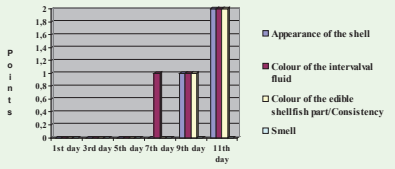
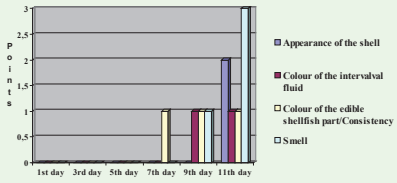
Table 1 **Evaluation of organoleptic characteristics of shellfish** according to Emilie Martinsdottir, DSc (Icelandic Fisheries Laboratories, 2002)

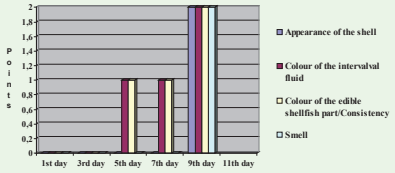
Indicators of shellfish quality	Description	Points
Appearance of the shell	- no overgrowth or impurities, edges intact	0
	- visible impurities, shell starting to open	1
	- half-open or fully open shell	2
Colour of the intervalval fluid	- characteristic, transparent, clear; sufficient quantity	0
	- darker (turbid); small quantity	1
	- no fluid	2
Colour of the edible shellfish part / Consistency	- characteristic, shiny	0
	- dried up, shiny, transparent meat, tough	1
	- dried up, dehydrated, dark	2
Smell	- characteristic, of the sea	0
	- slightly sour	1
	- of rot	2
	- unpleasant	3



Graph 1 **Sensory characteristics of oysters stored at the temperature of + 4° C**



Graph 2 **Sensory characteristics of oysters stored at the temperature of + 7° C**



Graph 3 **Sensory characteristics of oysters stored at the temperature of + 15° C**

et al., 2001; Nickelson et al., 2001). It may be added that shellfish in particular must have flawless sensory characteristics, because any deviation indicates spoilage and a danger to consumer health.

Materials and Methods

The samples of oysters in this study were taken from the Neum Gulf, from the beds of 'Ancora Commerce' Ltd. Neum. They were brought into the laboratory in a means of transport with a built-in cooling system, cooled at the temperature of 0° C. The viability of the oysters was analysed by recording the changes in sensory characteristics. The sensory characteristics were evaluated according to the method devised by Emilie Martinsdottir, DSc (Icelandic Fisheries Laboratories, 2002) and the Decision on the Manner of Veterinary Health Inspection and Control of Animals Before Slaughter and Animal Products (Table 1). The lowest score (0 points) indicates flawless sensory characteristics, while the highest score (9 points) indicates spoilage.

The analysis included 90 samples of oysters, stored at different temperatures (30 samples at the temperature of 4°C, 30 samples at the temperature of 7°C and 30 samples at the temperature of 15°C), each sample weighing 200 g. The oysters were stored for 11 days at the above mentioned temperatures (4°C, 7°C and 15°C) and their sensory characteristics were evaluated on the 1st, 3rd, 5th, 7th, 9th and 11th day of storage. The examined samples with changed sensory attributes, uncharacteristic of the product, were excluded from further study.

The sensory characteristics were assessed by five examiners. The examinations were done in the laboratory of the Department of Food Hygiene of the Faculty of Veterinary Medicine, University of Sarajevo, be-

Picture 1 **Oyster on the 7th day of storage (+4°C)**

Picture 2 **Oyster on the 9th day of storage (+4°C)**

Picture 3 **Oyster on the 11th day of storage (+4°C)**

tween May 2006 and May 2007.

Results and Discussion

Since shellfish are a very frequent cause of poisoning, great care is necessary in their preparation and consumption. The fact that shellfish meat is often consumed raw or underdone again increases the necessity of seafood processing and transport control (Hadžibeganović, 1975; Halliday et al., 1991; Herbert et al., 1991; Baltić and Teodorović, 1997; Mašić, 2004).

In this research oyster samples stored at different temperatures showed certain deviations in sensory characteristics, depending on storage period. The results are shown in Graphs 1, 2 and 3.

In the oyster samples stored at the temperature of + 4°C no changes in sensory characteristics were detected during the first five days. Only on the seventh day of storage a small quantity of turbid fluid inside the shell was recorded (Graph 1, Picture 1). The colour, the smell and the consistency of the edible part were characteristic of the product. On the ninth day, the shells were closed evenly but not tightly (loosened, easy to open). On opening, a much smaller quantity of turbid fluid was found inside the shell (Picture 2). The edible part of the shellfish was dried up and had the colour of stained glass, but the smell was still characteristic (of the sea).

In the samples stored at + 4°C, on the eleventh day the shells were ajar and easy to open. The colour of the meat was a little darker, the smell still characteristic of the product (Picture 3). The consistency of the meat was soft, but not disintegrating. The outward side of the shell was green. The average score on the last day of storage was 2 points (Graph 1) for all of the evaluated sensory characteristics except smell, for which no change was recorded (score 0).

Pictures 1 – 3 show the appearance of the oysters stored at the temperature of + 4°C at different stages of storage.

In the oyster samples stored at the temperature of + 7°C, on the seventh day the shells were closed but easy to open. The meat colour was somewhat darker (Picture 4), the smell still characteristic of the product. The meat consistency was soft, but not disintegrating (Graph 2). On the ninth day the shells were evenly but not tightly closed. On opening, a much smaller quantity of intervalval fluid was found inside the shell. The colour of the edible part was darker (green-brown), but still shiny, glassy (Picture 5). The smell was slightly sour, with the average score of 1 point (Graph 2).

On the eleventh day, the samples stored at the temperature of + 7°C had open shells (Picture 6). The outward side of the shell was green, and the inside was also turning green (from the edges toward the middle). On opening, slimy, clear fluid poured out. The meat was darker, but still had a glassy shine and a firm consistency. The smell of the meat was slightly unpleasant, reminiscent of rot, and the average score reached the maximum of 3 points (Graph 2).

Pictures 4 – 6 show the appear-

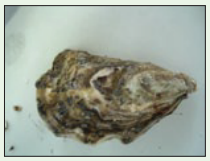
Picture 4 **Oyster on the 7th day of storage (+7°C)**

Picture 5 **Oyster on the 9th day of storage (+7°C)**

Picture 6 **Oyster on the 11th day of storage (+7°C)**

Picture 7 **Oyster on the 5th day of storage (+15°C)**

Picture 8 **Oyster on the 7th day of storage (+15°C)**



Picture 9 **Oyster on the 9th day of storage (+15°C)**

ance of the oysters stored at the temperature of + 7°C at different stages of storage.

The oyster samples stored at the temperature of + 15°C had tightly and evenly closed shells on the fifth day. On opening, the colour (Picture 7), the consistency and the smell of the edible part were characteristic of the product. There was less intervalval fluid. The average score on the fifth and on the seventh day of storage was 1 point (Graph 3). On the seventh day the shells were still closed tightly and evenly. There was less intervalval fluid (Picture 8). The smell and the colour of the edible part were characteristic of the product but the consistency was tougher.

On the ninth day, in the samples stored at + 15°C, the shells were completely open, and those that were not quite open had an unpleasant smell, of rot, upon opening. The colour of the edible part was dark and the consistency quite soft, disintegrating. The shell was green on the outside (Picture 9). The average score was 2 points (Graph 3). Due to the above mentioned changes, these samples were excluded from further study.

Pictures 7 – 9 show the appearance of the oysters stored at the temperature of + 15°C at different stages of storage.

In the evaluation of sensory characteristics, the samples stored at the temperature of 7°C had the highest score for smell on the eleventh day, while the other parameters (colour of the intervalval fluid, colour of the edible part and consistency) scored 1 point, excepting shell appearance, which scored the maximum 2 points.

The oysters stored at higher temperatures showed no deviations in sensory characteristics regarding shell appearance, the colour of the intervalval fluid, the colour of the meat, meat consistency and smell for 3 days (at 15°C), or for 5 days (at 7°C). The oysters stored at the temperature of maximum 4° C did not change their smell at all, and had flawless sensory characteristics for 5 days, the same as those stored at 7°C. However, on the 7th day of storage the colour of the intervalval fluid, the meat colour and consistency begin to change at lower temperatures as well (the average score of 1 point).

Pećarević and Bratoš (2004) pointed out the importance of preserving the sensory characteristics of shellfish, which, according to their research, was possible for the maximum of 22 days at the storage temperature of 4°C. The results of this study suggest otherwise. The oysters stored at the temperature of 4° C had flawless sensory characteristics for the period of nine days.

The current legislation in Croatia does not specify the shelf life of oysters.

Conclusion

Changes in sensory characteristics of shellfish vary according to refrigeration temperature. Oysters stored at 4°C and 7°C display changes on the seventh, and those stored at 15°C on the fifth day. The opening and the change in colour of the shell, both indicators of spoilage detectable by an average buyer, occur sooner at higher refrigeration temperatures, on the seventh or the ninth day.

*This paper is an abstract from the master's degree thesis of the author of 'The Effect of Cooling and Freezing on the Duration of Seafood', Faculty of Veterinary Medicine, University of Sarajevo. Mentor: Prof. Faruk Čaklovica, DSc.

References

Baltić M. Ž., V. B. Teodorović (1997): Higijena mesa riba, rakova i školjki, Beograd.

Čadež V., E. Teskeredžić (2005): Patogeni mikroorganizmi i toksini školjkaša koje prenose školjkaši iz onečišćenih područja-zoonoze", Ribarstvo, Vol. 63, No 4. 135-145.

Hadžibeganović, A. (1975): "Mikrobiologija mesa i mesnih prerađevina" Univetzitet u Sarajevu, Sarajevo.

Halliday M.L., L.Y. Kang, T.-K. Zhou, M.-D. Hu, Q.-C. Pan, T.-Y. Fu, Y.-S. Huang, and S.L. Hu (1991): An epidemic of hepatitis A attribuatable to the ingestion of raw clams in Shangai, China. J. Infect. Dis. 164: 852-859.

Herbert R., A., M. S. Hendrie, D.M. Gibson, J. M. Shewan (1971): Bacteria active in the spoilage of certain seafoods, J. Appl. Bacteriol. 34, 41-50.

Mašić, M. (2004): Higijena i tehnologija prerade školjaka. Meso VI, 40-45.

Orait D., S. Zrnić, M. Salajster (2001):

Einfluss der Kühlung auf sensorische Eigenschaften von Austern (Ostrea edulis)

Zusammenfassung

In Austernmustern (Ostrea edulis) wurden sensorische Eigenschaften nach der Bewahrung auf Temperaturen von 4°C, 7°C und 15°C in verschiedenen Zeitabschnitten (ein, drei, fünf, sieben, neun und 11 Tage) bewertet. Die Qualitätsindikatoren für Krebstiere (Gehäuseaussehen, Farbe des flüssigen Inhaltes der Muschel, Essteil, Konsistenz und Geruch) wurden mit 0 – 3 Punkten bewertet. Die Veränderung der sensorischen Eigenschaften auf den Austernmustern gelagert bei Temperaturen von 4°C und 7°C erfolgten am siebten Tag, während die Veränderungen auf den Austernmustern gelagert bei Temperatur von 15°C am fünften Tag beobachtet wurden.

Schlüsselwörter: *Auster, Kühlung, sensorische Eigenschaften*

Influenza del raffreddamento sulle caratteristiche sensoriche di ostriche (Ostrea edulis)

Sommario

Nei campioni di ostriche (Ostrea edulis) sono qualificate le caratteristiche sensoriche dopo l'immagazzinamento sulle temperature di 4°C, 7°C i 15°C durante diversi periodi del tempo (uno, tre, cinque, sette, nove e undici giorni). Gli indicatori di qualità di bivalvi (aspetto di crosta, colore del contenuto liquido, della sua parte mangiabile, consistenza e odore) sono stati valutati da 0 a 3 punti. I cambi delle caratteristiche sensoriche sui campioni immagazzinati sulle temperature di 4°C e 7°C sono apparsi il settimo giorno, e sulla temperatura di 15°C i cambiamenti sono stati notati il quinto giorno d'immagazzinamento.

Parole chiave: *ostriche, raffreddamento, caratteristiche sensoriche*

Preventiva, kontrola bolesti i ocjena kakvoće riba i školjka. Tečaj. Projekt: Razvitak službi za potporu obiteljskim poljoprivrednim gospodarstvima. Hrvatski veterinarski institut. Zagreb.

Pećarević M., A. Bratoš A. (2004): Standardi kakvoće, prerada i pakovanje kamenica"Naše more" 51 (1-2), 69-73.

Nickelson, R. I, S. McCarthy, G. Finne (2001): Fish, crustaceans, and precooked seafoods. In: Downes, F.P., Ito, K. (Eds.), Compendium of Methods for the Microbiological Examination of Foods, fourth ed. American Public Health Association, Washington, DC, pp. 497–505.

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Ensuring quality in primary production of meat

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professional paper

Summary

This paper gives an overview of the importance of setting up a system based on the principles of hazard analysis and critical control points (HACCP). In the Republic of Croatia today, the Food Act (OG 46/07) requires food businesses to establish a quality control system based on the HACCP principles. The system presents the application of preventative measures which reduces the concept of risk analysis to the lowest possible level. Preventative measures, if effectively applied to known critical points, reduce the likelihood or appearance of risk to an acceptable level.

The HACCP system consists of seven principles, and its implementation is carried out in twelve steps. Directly after the establishment of the system, it is necessary to educate and train the employees. However, a long-term functioning of the system can only be ensured through the regular revision of documentation and the HACCP plans in order to keep it up to date with any changes that have taken place.

Key words: *quality, quality control, HACCP.*

Introduction

The term "food safety" becomes more frequent every day and it implies health safety and suitability of food for human nutrition in accordance with its purpose. Considering the given definition, safe food is possible to be produced by ensuring adequate hygienic conditions in the production plant and a complete monitoring of the production process in order to enable a timely response at possible appearance of a problem. Therefore, many legal regulations whose implementation should ensure the production of safe food have been adopted in the Republic of Croatia in the last couple of years in the aim of their approximation with the ones in force in the EU countries. In doing so, a commitment often appears to establish and implement a system based on the principles of hazard analysis and critical control points (Hazard Analysis Critical Control Point – HACCP) by all food business entities (FBE), except for those on the level of primary production.

A proper application of HACCP system requires existing scientifically documented procedures and preventative measures to be efficiently applied to the known critical control points (CCP). Determining critical control points in the aim of implementation at the level of primary production/farms is possible for chemical, physical and certain biological dangers, but it is considered to be insufficient for all microbiological dangers. Therefore, most of the activities which are carried out on farms are based on prerequisite programs which offer basic environmental conditions and businesses necessary for the production of safe food.

The first legal requirement for the introduction of procedures based on the principles of HACCP system in the Republic of Croatia has been proscribed by the Regulation on the implementation of obligatory measures in approved facilities in order to reduce microbial and other contamination of meat, meat products and other products of animal origin intended for human consumption (Anonymous, 1997). By provisions of the Food Act 2003 (Anonymous, 2003), this requirement has been expanded to all food business entities (FBE), but since it was impossible to be enforced, the intended date of entry into force (15 July 2006) was prolonged up to 1 January 2009. A legal framework which, among other things, defines application, monitoring of the application and the revision of procedures based on the principles of HACCP system, has in the meantime been approximated with the acquis communautaire of the EU in the Food Act 2007 (Anonymous, 2007a), the Ordinance on the hygiene of food of animal origin (Anonymous, 2007b),the Ordinance on official controls performed to ensure the verification of compliance with food and feed laws, as well as animal health and animal welfare rules, and the Ordinance on official controls of prod-

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