## Kontrolle von Malachitgrüne in den Erzeugnissen der Aquakultur

**Zusammenfassung**

*Das Malachitgrüne (MG) wird traditionell als Tryphenilmetanfarbe in Textilindustrie, als Pigment und als Nahrungsadditiv benutzt. In der Fischzucht wird es als wirkungsvolles Fungizid, Parisitizid, Antiprotosoan und Bakteriozid benutzt. Im Fischorganismus metabolisiert sich das MG in Leukomalachitgrüne (LMG), das wegen seiner lipophylen Eigenschaften eine längere Zeit im Fettgewebe anhält. Zahlreiche Untersuchungen in vitro und in vivo zeigten zytotoksische, kanzerogene, mutagene und teratogene Eigenschaften von MG und LMG vor. Deshalb ist die Anwendung von MG verboten bei Tierarten, die für die menschliche Nahrung bestimmt sind, u.zw. in den USA und in der EU. Trotzdem wird das MG immer noch in der intensiven Fischerei benutzt, so befinden sich Reste von MG und LMG am häufigsten in Inzidenz der nicht erlaubten Substanzen in den Erzeugnissen der Aquakultur. Die EU hat deshalb die Grenze der mindest erforderlichen Wirksamkeit der Methodendurchführung MRPL (engl. minimum required performance limit) von 2 µg/kg für die Bestimmung von MG und LMG vorgeschrieben.Heutzutage werden für die Quantifikation von MG und LMG im Fischgewebe Methoden der Flüssigkeitschromatographie und Flüssigkeitschromatographie der Tandemspektometrie der Massen verwendet. Trotz des Verbotes in den Ländern der EU werden systematisch erhöhte Konzentrationen von MG und LMG in allen Fischen und Fischerzeugnissen vorgefunden. In der Zeitspanne von 2002 und 2011 wurden durch die schnelle Warnung für Nahrung und Tiernahrung RASFF ( engl. Rapid Alert System for Food und Feed) erhöhte Konzentrationen von MG und LMG bei 123 Fischarten und Fischerzeugnissproben vorgefunden. Die höchste Zahl von 50 Proben wurde im Jahr 2005 notiert. In der Gesamtzahl der Muster waren 47 Muster aus Vietnam, 12 aus Indonesien, 10 aus China und 3 aus Thailand, bzw. 58,5 % der Muster stammte aus Asien. Demzufolge ist die Kontrolle der MG und LMG außerordentlich wichtig für den Gesundheitsschutz der Verbraucher.*

***Schlüsselwörter:*** *Malachitgrüne, Leukomalachitgrüne, Fische, Aquakultur*

## Controllo del verde di malachite nei prodotti di acquacoltura

**Sommario**

*Il verde di malachite (VM) di solito si usa come il colore trefenilmetanico nell'industria tessile, come il pigmento e anche come l'additivo alimentare. Nell'allevamento di pesci viene usato come un fungicido molto efficiente, parasitícide, antiprotosoico e batterocido. Nell'organismo del pesce il VM si metabolizza nel verde leucomalachite (VLM) che, per le sue caratteristiche lipofili, si mantiene nel tessuto grasso per un periodo più lungo. Numerose ricerche in vitro hanno dimostrato le caratteristiche citotossiche, cancerogene, mutagene e taretogene del VM e del VLM. Perciò l'uso del VM è proibito dalle sorte alimentari destinate all'alimentazione umana negli Stati Uniti e nell'Unione europea. Nonostante questa proibizione il VM si usa ancora nell'intensa pesca negli stagni ed i residui di VM e VLM appaiono più spesso nell'incidenza delle materie non permesse nei prodotti dell'acquacoltura. Perciò l'Unione europea ha prescritto il limite della meno richiesta efficienza di esecuzione di metodi (MRPL, in inglese minimum required performance limit) di 2 µg/kg per determinare i VM e VLM. Oggi per quantificare i residui di VM e VLM nei tessuti del pesce si applicano i metodi della cromatografia di liquidi e della cromatografia di liquidi di spettrometria delle masse. Nonostante il divieto dell'uso negli paesi dell'Unione europa si scoprono sistematicamente le percentuali aumentate dei VM e VLM in tutti i tipi del pesce e dei prodotti di pesce. Nel periodo dal 2002 al 2011 tramite il sistema dell'allarme urgente per gli alimentari e gli alimentari per gli animali (RASFF, in inglese Rapid Alert System for Food and Feed) le percentuali aumentate dei VM e VLM sono state determinate in 123 campioni del pesce e dei prodotti di pesce. Il numero più grande di 50 campioni è stato registrato nel 2005. Dal numero totale di campioni positivi 47 di loro sono di Vietnam, 12 di Indonesia, 10 di Cina e 3 di Tailanda, cioè il 58,5% di campioni provengono dall'Asia. Da questo segue la conclusione che il controllo dei VM e VLM è importantissimo per la protezione sanitaria di consumatori.*

***Parole chiave:*** *verde di malachite, verde leucomalachite, pesce, acquacoltura*

82(3), 280-286.

**Rao, K. V., D. M. Mahudawala, A. A. Redkar** (2001): Abrogation of cell cycle checkpoint controls during malignant transformation of syrian hamster embryo cells is associated with decreased sensitivity to apoptosis. J. Environ. Pathol. Toxicol. Oncol. 20(3), 177-188.

**RASFF** (2011): Rapid alert system for food and feed: Dostupno na:https:/ /webgate. ec. europa. eu/ rasff-window/portal/index.cfm?event=searchResultList&StartRow=101

**Renwick, A., J.-C. Leblanc, R. W. Setzer** (2010): Application of the margin of exposure (MOE) approach to substances in food that are genotoxic and carcinogenic. Example: Leucomalachite green. Food Chem. Toxicol. 48, S75-S80.

**Stammati, A., C. Nebbia, I. D. Angelis, A. G. Albo, M. Carletti, C. Rebecchi, F. Zampaglioni, M. Dacasto** (2005): Effects of malachite green (MG) and its major metabolite, leucomalachite green (LMG), in two human cell lines. Toxicol. In Vitro. 19(7), 853-858.

**Singh, G., T. Koerner, J.-M. Gelinas, M. Abbott, B. Brady, A.-C. Huet, C. Charlier, P. Delahaut, S. B. Godefroy** (2011): Design and characterization of a direct ELISA for the detection and quantification of leucomalachite green. Food Addit. Contam. A 28, 731-739.

**Tao, Y., D. Chen, X. Chao, H. Yu, P. Yuanhu, Z. Liu, L. Huang, Y. Wang, Z. Yuan** (2011): Simultaneous determination of malachite green, gentian violet and their leuco-metabolites in shrimp and salmon by liquid chromatography–tandem mass spectrometry with accelerated solvent extraction and auto solid-phase clean-up. Food Control 22, 1246-1252 .

**Tarbin, J. A., K. A. Barnes, J. Bygrave, W. H. H. Farrington** (1998): Screening and confirmation of triphenylmethane dyes and their leuco metabolites in trout muscle using HPLC-vis and ESP-LC-MS. Analyst 123 (12), 2567-2571.

**Tripathi, M., S. K. Khanna, M. Das** (2007): Surveillance on use of synthetic colours in eatables *vis a vis* Prevention of Food Adulteration Act of India. Food Contr. 18, 211-219.

**Van de Riet, J. M., C J. Murphy, J. N. Pearce, R. A. Potter, B. G. G. Burns** (2005): Determination of malachite green and leucomalachite green in a variety of aquacultured products by liquid chromatography with tandem mass spectrometry detection. J. AOAC Int. 88, 744-749.

**VRC** (2001-2010): Veterinary Residues Committee's Annual Report on surveillance for Veterinary Residues in Food in UK for 2001 to 2010. Dostupno na: http://www.vmd.defra.gov.uk/vrc/Reports/annual.htm

**Xing, W., L. He, H. Yang, C. Sun, D. Li, X. Yang, Y. Li, A. Deng** (2009): Development of a sensitive and group-specific polyclonal antibody-based enzyme-linked immunosorbent assay (ELISA) for detection of malachite green and leucomalachite green in water and fish. J. Sci. Food Agric. 89, 2165–2173.

**Yang, M. C., J. M. Fang, T. F. Kuo, D. M. Wang, Y. L. Huang, L. Y. Liu, P. H. Chen, T. H. Chang** (2007): Production of antibodies for selective detection of malachite green and the related triphenylmethane dyes in fish and fishpond water. J. Agric. Food Chem. 55, 8851–8856.

Received: December 2, 2011.
Accepted: April 1, 2012.







# Farming of mussels (*Mytilus galloprovincialis*) as safe food

Džafić[1] , N. , T. Fumić[2] , B. Njari[3]

*review*

**Summary**

*Shellfish and crab production is an ancient, traditional trade, which has lately become a profitable industry connected with tourism. In Croatia some 3 000 tons of mussels are produced annually and sold exclusively on the domestic market, as delicious quality food with singular sensory traits and high quality proteins. Mussels harvested for the domestic market meet the requirements of the Regulation on the hygiene of food of animal origin (NN 97/2007) and as such are delivered to dispatch centers, where they are packaged. In addition to monitoring in production areas and relaying areas, a monitoring system which includes laboratory testing has also been set up for food business operators, with the aim of establishing whether they meet the requirements for the final product in all phases of production and distribution. Apart from these control measures, it is also important to maintain good hygiene practices (and the HACCP system) during transportation and storage of shellfish, with the aim of protecting consumer health.*

***Keywords:*** *mussels, monitoring*

## Introduction

Shellfish and crab production is an ancient, traditional trade, which has lately become a profitable industry connected with tourism. In Croatia some 3 000 tons of mussels are produced annually and sold exclusively on the domestic market. What makes shellfish special is the fact that they are sold live and are the most valued as live, rather than thermally processed, with the meat separated from the shell. Live shellfish are a delicacy, eaten raw or only slightly thermally processed.

## Mussel Farming and Harvesting

All shellfish, including mussels, are very good for human nutrition because they contain high quality proteins and have distinctive sensory traits. Due to the constantly increasing exploitation of natural sources of bivalve shellfish, the density in natural habitats is significantly reduced and it is now an imperative to intervene by creating farming areas. The coastal areas of estuaries are the most productive and are being densely populated by shellfish for use in the food industry. Shellfish are usually bred on vertical lines, the so - called pergolari, and in baskets. Collectors may collect and harvest live shellfish only in production areas which have defined location and boundaries, and have been classified by an authorized body into classes A, B or C. Shellfish are harvested when they have reached commercial size, which depends, among other things, on the farming method. The vertical lines ('pergolari') and baskets are drawn out of the sea and shellfish are 'harvested', then washed in pure sea water to remove slime and algae, and sent to dispatch centers. Shellfish living at the bottom of the sea are harvested by special fishing tools (rapido trawls, mussel rakes, dredges) dragged along the sea bottom, or by divers.

Production areas have to be classified in accordance with the Regulation on the official control of food of animal origin (Anon., 2007, c). Shellfish harvested in a class A production area may be directly transported to dispatch centers, whereas those harvested in a class B area may be placed on the market for human consumption only after processing in a depuration facility or a relaying center. Shellfish from a class C harvesting area may be placed on the market only after relaying over a long period.

## Dispatch Centers and Depuration Centers

Harvested shellfish to be placed on the market are transported to dispatch centers and packaged there. Dispatch centers may process only shellfish which meet the requirements of the Regulation on the hygiene of food of animal origin (Anon., 2007, b), i.e. shellfish from the class A harvesting area or from a relaying area or a depuration center or another dispatch center.

Shellfish which have to be purifi-

[1] **Natalija Džafić, M.Sc.**, Croatian Veterinary Institute, Veterinary Department in Rijeka, Podmurvice 29, Rijeka
[2] **Tihana Fumić, V. M. D.**, ZO-INVEST Ltd., Mirogojska 16, Zagreb
[3] **Bela Njari, PhD**, full professor, University of Zagreb, Faculty of Veterinary Medicine, Department of Food Hygiene and Technology, Heinzelova 55, Zagreb

ed in a depuration center must first be cleansed of slime and accumulated dirt, and the purification system has to enable live shellfish to quickly start and continue feeding through filtration, extract the remainders of contamination caused by sewage and wastewater and prevent recontamination. Purified shellfish have to be alive in order to be packaged, stored and prepared for transport before marketing. All the processes, as well as the conditions to be complied with by depuration centers, are illustrated in the Guide for food business operators in depuration facilities for live shellfish (Anon., 2011).

## Legal Provisions

In spite of many efforts to ensure food safety, numerous episodes of alimentary bacterial infections and intoxications are still recorded worldwide. The introduction of the HACCP system in the food industry has significantly improved food safety, but it is still not possible to completely eliminate pathogens from primary food production, especially for food sold without prior thermal processing. As part of the alignment of Croatian legislation with the EU acquis communautaire, Croatia has set up a monitoring system, with the Plan for monitoring sea and shellfish quality in live shellfish farming and relaying areas (Anon., 2010, a).

The primary purpose of this plan is:

- to test the microbiological quality of live shellfish in farming and relaying areas;
- to test for presence of toxic plankton and potentially toxic plankton in the waters of farming and relaying areas, and of biotoxins in live shellfish;
- to test for presence of chemical contaminants in live shellfish;
- to avoid abuse regarding the origin of live shellfish;
- to perform preliminary analyses of new production areas.

Systematic monitoring according to annual Plans was introduced in 2005 (Anon., 2005, a) and changes since have included varying numbers of production areas, continuous sampling points and sampling dynamics. The division of production areas has stabilized since 2007. Some areas have been monitored as preliminary areas, and sampling of shellfish in order to determine their microbiological quality has been done at three farming levels for some areas (Anon., 2007, a).

According to the Regulation on the hygiene of food of animal origin (Anon., 2007, b), in addition to compliance with the microbiological criteria (230 MPN of *E. coli* per 100 g of meat and intervalvular fluid – Anon., 2008.b), food business operators also have to ensure that live shellfish placed on the market for human consumption meet the following requirements:

1. they must have sensory traits characteristic of fresh and vital shellfish: their shell may not be dirty, they have to respond to percussion appropriately and have a sufficient amount of intervalvular fluid
2. they may not contain total levels of marine biotoxins (measured in the entire body or in all edible parts separately) above those prescribed for
   a) biotoxins which cause paralysis (Paralytic Shellfish Poison – PSP): 800 micrograms per kilogram;
   b) biotoxins which cause memory loss (Amnesic Shellfish Poison – ASP): 20 milligrams of domoic acid per kilogram;
   c) okadaic acid, dinophysis toxins and pectenotoxins together: 160 micrograms of okadaic acid equivalent per kilogram;
   d) yessotoxins: 1 milligram of yessotoxin equivalent per kilogram;
   e) azaspiracids: 160 micrograms of azaspiracid equivalent per kilogram.

Shellfish producers suffer losses when mussels cannot be marketed due to the presence of biotoxins or a greater number of *Escherichia coli* in the meat and intervalvular fluid. The highest level of *E. Coli* allowed for the direct marketing of live shellfish is 230 MPN in 100 g of meat and intervalvular fluid (Anon., 2008, b). In case of an increase in the count of *E. coli*, producers have two options: to send shellfish to a depuration center or a relaying center. In both cases, they have to wait until the number of microorganisms is below the highest level allowed, whereby purification as described above is still of questionable effectiveness and time-consuming. Purification in depuration facilities lasts for at least two days and in relaying centers for at least two months. If the presence of biotoxins is established, the authorized veterinary inspector issues a ban on harvesting and/or collecting, trafficking and marketing of live shellfish in the area from which the contaminated shellfish originated, and sampling of live shellfish to be tested for biotoxins in the source area every 48 hours, until the level of biotoxins has been reduced to comply with the sanitary conditions for live shellfish (Anon., 2009, a).

## Classification of Production Areas

Based on tests of shellfish meat and intervalvular fluid for the most probable number of *Escherichia coli*, carried out on official control samples, the authorized body classifies production areas, determines their locations and boundaries and sets up continual monitoring of the areas. Production areas may be ranked into three classes, depending on the level of fecal contamination established in tests of at least 12 samples collected at regular intervals during the period of minimum 12 months (Table 1. Classification Criteria).







Table 1. **Classification Criteria for the Classification of Shellfish Farming Areas and Relaying Areas ( Anon., 2010, a)**

| Class | Microbiological standard | Necessary treatment after harvest |
|---|---|---|
| A | Live bivalve shellfish in this class may not exceed the level of 230 MPN* of *E. coli* in 100 g of meat and intervalvular fluid (ISO/TS 16649-3) | None |
| B | Live bivalve shellfish in this class may not exceed the level of 4 600 MPN* of *E. coli* in 100 g of meat and intervalvular fluid (ISO/TS 16649-3) | Purification, relaying or thermal processing by authorized procedures |
| C | Live bivalve shellfish in this class may not exceed the level of 46 000 MPN* of *E. coli* in 100 g of meat and intervalvular fluid (ISO/TS 16649-3) | Relaying or thermal processing by authorized procedures |

*MPN /most probable number

For the purposes of classification, the authorized body makes up a list of human and animal contamination sources that might cause contamination in the given farming area. Furthermore, it tests the levels of organic contaminants released during different seasons, depending on the seasonal changes in human and animal populations in the basin, the levels of precipitation, sewage and wastewater treatment etc. Contaminant circulation traits are established based on the effects of currents, bathymetry and tides in the farming area. Based on an analysis of the obtained data, a shellfish sampling plan for the area is created, stating the number of samples, the geographical distribution of sampling points and sampling frequency, which are to ensure that the results of analysis are representative as much as possible of the given area. After the production areas have been classified, a Plan for monitoring sea and shellfish quality in live shellfish farming and relaying areas is drawn up. Until 2010 a new Plan was created each year, but it has been constant since. The Plan must consider possible fluctuations in fecal bacteria contamination, fluctuations in the presence of biotoxins - producing phytoplankton, and the possible presence of chemical contaminants.

## Contamination

### A) Microbiological Contamination

When sampling results show that the sanitary requirements for shellfish have not been met or that there is any danger to human health, the authorized veterinary inspector must act in accordance with the Regulation on microbiological classification and procedure in case of live shellfish contamination (Anon., 2009, a). This Regulation prescribes the procedure for classification of preliminary production areas and the course of action to be taken by state veterinary inspectors, authorized shellfish samplers and authorized laboratories in case of microbiological and biotoxin contamination.

If tests of shellfish samples from class A production areas reveal the most probable number (MPN) of *Escherichia coli* to be 230 to 4 600 /100 g of meat and intervalvular fluid, the authorized laboratory must immediately notify the authorized veterinary inspection office. The authorized veterinary inspector then informs all the registered shellfish producers and collectors, depuration facilities and dispatch centers, and issues a directive ordering purification of shellfish in depuration facilities or relaying areas. The same directive orders resampling in the area on the seventh and tenth day from the date when the sample with a positive *E. coli* finding was taken. If the tests of both new samples find less than 230 MPN of *E. coli* per 100 g of meat and intervalvular fluid, the veterinary inspector may lift the obligation of purifying shellfish. If one of the samples contains more than 230 MPN of *E. coli*, the obligation of purifying shellfish remains, and a formal decision is made to reclassify the area into class B or C. If values obtained by sampling in the same area during the next three months are higher than 230 MPN of *E. coli* per 100 g, the authorized veterinary inspector makes a formal decision to reclassify the area in the appropriate microbiological class, without resampling.

If tested shellfish samples from the class A or class B farming area are found to contain the MPN of *E. coli* between 4 600 and 46 000 / 100 g of meat and intervalvular fluid, the steps to be taken by the authorized laboratory and veterinary inspector are the same as described above. Depending on the results of resampling, two procedures are possible. If both new samples contain between 230 and 4 600 MPN of *E. coli* per 100 g, the veterinary inspector orders shellfish purification in depuration facilities or relaying areas. If both new samples contain between 4 600 and 46 000 MPN of *E. coli* per 100 g, the area is classified as class C and is thereafter treated as all class C areas (obligatory shellfish purification in relaying areas or thermal processing).

If resampling in the area shows good results and the area remains class A or class B, microbiological content is monitored for the following three months. If a single result during this period is above the values allowed for the microbiological class of the given area, the veterinary inspector reclassifies the area into a lower class, without resampling.

Should the MPN of *E. coli* in samples exceed 46 000/100 g, the authorized laboratory must immediately inform the authorized veterinary inspector, who in turn informs all other shellfish business operators. The veterinary inspector also issues a formal decision banning traffic of harvested shellfish and ordering resampling on the seventh and tenth day. If the results of both new samples are below 46 000 MPN of *E. coli*/100 g, the area is classified as class C. If the results show more than 46 000 MPN *E. coli*/100 g, the veterinary inspector issues a ban on shellfish harvesting and collecting in the area. The area continues to be monitored, and if the subsequent three samplings all show values within the limits of a higher microbiological class, the veterinary inspector issues a decision of reclassifying the area, thereby lifting the ban on shellfish harvesting and collecting.

In all three cases of microbiological contamination, purification of shellfish may be replaced by thermal processing in authorized facilities in the following manner:

(a) sterilization in hermetically sealed containers or
(b) thermal processing which includes
- immersion in boiling water until internal meat temperature reaches a minimum of 90° C and maintenance of this temperature for at least 90 seconds;
- cooking for a period of three to five minutes in a closed container with a temperature of 120° C to 160° C and the pressure of 2 kg/cm$^2$ to 5 kg/cm$^2$, after which the shell is detached from the meat and the meat is frozen until its internal temperature reaches –20° C;
- exposure to steam under pressure in a closed container, whereby the requirements for cooking time and internal temperature of mollusk meat have to be met (ANON., 2007, a).

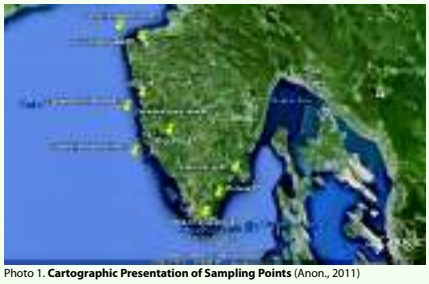

Photo 1. **Cartographic Presentation of Sampling Points** (Anon., 2011)

**B) Biotoxin Contamination**

When an authorized laboratory finds biotoxin levels in a live shellfish sample greater than allowed, it immediately informs the authorized veterinary inspection office. The veterinary inspector forwards the information on biotoxin presence as soon as possible to shellfish producers, collectors, depuration centers, dispatch centers, the sanitary inspection office, local health centers, the Croatian National Institute of Public Health, the Croatian Chamber of Trades and Crafts, the Ministry of the Interior and the Ministry of Agriculture – Veterinary Directorate. An oral decree is issued immediately, and within 24 hours a written decree banning harvesting, collecting and trafficking of live shellfish harvested in the area which tested positive for biotoxins. Sampling of live shellfish is scheduled every 48 hours, until biotoxin level is below the maximum allowed. The closed harvesting area may be reopened only after two samplings have had results within the prescribed limit.

## Monitoring

Regular veterinary monitoring of production areas and relaying areas includes checks on:

- abuse regarding live shellfish origin and destination;
- microbiological quality of live shellfish with respect to production areas and relaying areas;
- presence of toxin-producing plankton in the waters of production areas and relaying areas and biotoxin presence in live shellfish;
- presence of chemical contaminants in live shellfish.

## Inspection of Dispatch Centers, Depuration Centers and Relaying Areas

In addition to monitoring of production areas and relaying areas, a monitoring system which includes laboratory testing has also been set up for food business operators (FBOs), with the aim of establishing whether they meet the requirements for the final product in all phases of production, processing and distribution. This system makes certain that levels of marine biotoxins and contaminants do not exceed safety limits and that the microbiological quality of shellfish does not pose a danger to human health. While inspecting dispatch centers, the authorized veterinary inspector looks into the self - control procedures of FBOs, and especially the compliance of products with the prescribed conditions. The veterinary inspector performs official controls with the purpose of ensuring that FBOs comply with certain requirements of the Regulation on official controls of food of animal origin (Anon., 2007, c) relating to the provisions of the Regulation on the hygiene of food, the Regulation on the hygiene of food of animal origin and the Regulation on animal by - products not fit for human consumption.

Official controls of dispatch centers and depuration centers also include audits of good hygiene practices (GHP) and procedures pertaining to the application of HACCP-based principles. Audits of GHP verify that FBOs continuously and properly apply procedures concerning at least the general official control principles (Anon., 2007, c):

(a) checks on food chain information;
(b) the design and maintenance of premises and equipment;
(c) pre - operational, operational and post-operational hygiene;
(d) personal hygiene of staff;
(e) training in hygiene and in work procedures;
(f) pest control;
(g) water quality;
(h) temperature control;
(i) control of food entering and leaving the establishment;
(j) control of accompanying documentation.

Audits of HACCP-based procedures are to verify that FBOs apply the procedures continuously and properly, and especially to determine whether the procedures guarantee compliance with the Regulation on the hygiene of food of animal origin (Anon., 2007, b) and compliance of products of animal origin with the sanitary conditions prescribed for live shellfish (Anon., 2007, b), i.e. that the products:

(a) comply with the microbiological criteria (Anon., 2007, c, Anon., 2007, b, Anon., 2008, b);
(b) do not contain biotoxins above permitted levels (Anon., 2007, c);
(c) do not contain chemical contaminants (Anon., 2008, c).

Dispatch centers are inspected for compliance of products with the Regulation on the hygiene of food of animal origin (Anon., 2007, b) and with the general requirements for the release of live shellfish to market (product identification label, accompanying documentation, collector's name and address, collecting/harvesting date, location of the farming area described in as much detail as possible or marked with a numerical code, health status of the farming area, shellfish type and quantity, destination of the product line). Documentation which accompanies products from a relaying area should, among other things, contain information on the location of the relaying area and the duration of relaying. Shipments from a depuration center should, among other things, contain information on the depuration center, the date of delivery to the center and the dates for the beginning and the end of the purification process. In addition, documentation on the effectiveness of purification in the center should be reviewed. Proof of effectiveness of a depuration center must be substantiated by reports of an authorized laboratory, drawn up prior to the opening of the center, and then checked at regular intervals as part of self - control, in accordance with the Guide for food business operators in depuration facilities for live shellfish (Anon., 2011, EU Working Group on Microbiological Monitoring of Bivalve Mollusk Harvesting Areas, 2007). In order for shellfish to be marketed via a dispatch center, they must first be examined for compliance with the prescribed sanitary requirements for live shellfish, as mentioned above (Anon., 2007, b).

**In lieu of a conclusion** it should be reminded that water organisms, though being of great benefit to humans, also pose a real danger to human health. Shellfish may contain levels of toxins, microorganisms and heavy metals that exceed the allowed limits. By regular sampling of sea water for phytoplankton makeup and of shellfish for presence of heavy metals, *E. coli* and biotoxins, negative consequences to human health may be reduced to the lowest possible level. Wild harvested shellfish pose a separate problem, since their harvest areas are not controlled. In addition to these controls, it is important to maintain good hygiene practices during transportation and storage of shellfish. Preparation at home is also significant, whereby more attention should be paid to thermal processing. It should also be noted that highly sensitive consumer groups are at the greatest risk. However, considering the eating habits of Croatian consumers, who on average eat less than 8 kg of fish and shellfish a year, the health risks of shellfish and fish consumption are relatively low. Food safety is the basic requirement to be met by all food producers and other food business operators, and this is why shellfish safety and hygiene is important.

* This paper is an abstract from the master thesis by Natalija Džafić: Effect of Systematic Monitoring of Hygienic Quality in Mussels (*Mytilus galloprovincialis*) on the Territory of Istria County. Master Thesis. University of Zagreb, Faculty of Veterinary Medicine, p. 141, 2012 (Mentor: Bela Njari, Prof. PhD)

## References

**Anonimno** (2005.a): Plan praćenja kvalitete mora i školjkaša na područjima uzgoja, izlova i ponovnog polaganja školjkaša. NN 53/2005

**Anonimno** (2007.a): Plan praćenja kvalitete mora i školjkaša na područjima uzgoja, izlova i ponovnog polaganja za 2007. godinu. NN 49/2007

**Anonimno** (2007.b): Pravilnik o higijeni hrane životinjskog podrijetla. NN 99/2007

**Anonimno** (2007.c): Pravilnik o službenim kontrolama hrane životinjskog podrijetla. NN

## Die Zucht von Pfahlmuscheln (Mytilus galloprovincialis) als sichere Nahrung

**Zusammenfassung**

*Die Erzeugung von Krebstieren und Krebsen ist eine Tätigkeit, die aus den früheren Zeiten stammt. Sie ist traditionell mit der Bewohnerschaft verbunden. In der letzten Zeit entwickelt sich in eine einträgliche Industrie, die mit dem Tourismus verbunden ist. In Kroatien werden jährlich etwa 3 000 Tonnen Pfahlmuscheln erzeugt, die ausschließlich auf dem Binnenmarkt placiert werden, als schmackhafte und sehr gute Nahrung von eigenartigen sensorischen Eigenschaften und qualitativ sehr guten Qualität. Gefangene Krebstiere, bestimmt für die Marktzwecke, entsprechen den Verordnungen der Dienstvorschrift über Hygiene der Nahrung animaler Herkunft (Anon., 2007.b) und als solche werden sie in die Distributionszentren geliefert, wo sie in Emballageeinheiten verpackt werden. Neben dem Monitoring in Erzeugungsgebieten und Gebieten für neues Anlegen, ist ein Kontrollsystem entwickelt worden, das Laboruntersuchungen einschließt, mit dem Ziel der Überprüfung der Subjekte, die mit Nahrung handeln, im Sinne der Erfüllung von Forderungen für Endprodukte in allen Herstellungsphasen und Distribution. Neben der angeführten Kontrolle ist es wichtig, eine gute hygienische Praxis (und HACCP System) beim Transport und Lagerung der Krebstiere mit dem Ziel des Verbraucherschutzes durchzuführen.*

***Schlüsselwörter:*** *Pfahlmuschel, Kontrolle*

## Allevamento di cozze (Mytilus galloprovincialis) come alimentari sicuri

**Sommario**

*La produzione di molluschi e granchi è conosciuta già dai tempi antichi, ed è tradizionalmente legata alla popolazione, e negli ultimi tempi sta diventando un'industria che porta molto denaro essendo legata strettamente al turismo. In Croazia vengono prodotte 3 000 tonellate di cozze, che poi si offrono e vendono solo al mercato domestico come un alimentare gustoso e di qualità, dalle particolari caratteristiche sensoriche, e con una notevole percentuale di proteine. I molluschi destinati al mercato sono contemporaneamente conformi alle norme del Regolamento di igiene degli alimentari di origine animale (Anon., 2007 b) e come tali arrivano negli centri di distribuzione dove vengono confezionati nelle unità d'imballaggio. Insieme con il monitoraggio nelle aree di produzione e nelle aree per un nuovo deposito, è stato stabilito anche il sistema di sorveglianza in cui si eseguono le ricerche laboratoriche con lo scopo di controllare tutte le fasi di produzione e distribuzione. Per proteggere la salute di consumatori è molto importante una buona prassi igienica (ed il sistema HACCP) durante il trasporto e l'imballaggio di molluschi.*

***Parole chiave:*** *cozze, sorveglianza*

99/2007

**Anonimno** (2008.b): Pravilnik o mikrobiološkim kriterijima za hranu. NN 74/2008

**Anonimno** (2008.c): Pravilnik o najvećim dopuštenim količinama određenih kontaminanata u hrani. NN 154/08

**Anonimno** (2009.a): Pravilnik o mikrobiološkom razvrstavanju i postupku u slučaju onečišćenja živih školjkaša. NN 118/2009

**Anonimno** (2010.a): Plan praćenja kakvoće mora i školjkaša na proizvodnim područjima i područjima za ponovno polaganje živih školjkaša. NN 37/2010

**Anonimno** (2011.): Vodič za subjekte u poslovanju s hranom u objektima za pročišćavanje živih školjkaša. http://www.mps.hr/

**Anonimno** (2007): Communitiy Guide to the Principles of Good Practice for the Microbiological Monitoring of Bivalve Mollusc Harvesting Areas with regard to Regulation 854/2004. EU Working Group on Microbiological Monitoring of Bivalve Mollusc Harvesting Areas. www.crlcefas.org.

**Džafić, N.** (2012): Učinak sustavnog praćenja higijenske ispravnosti dagnji (*Mytilus galloprovincialis*) na području Istarske županije. Znanstveni magistarski rad. Veterinarski fakultet Zagreb. str. 141.

Received: May15, 2012
Accepted: June 28, 2012









# Consumer opinion on influence of animal welfare to meat quality during processing

Mijatović[1], D., T. Mikuš[2], Ž. Mesić[3], B. Njari[2], Ž. Cvrtila Fleck[2], L. Kozačinski[2]

*short communication*

**Summary**

*In recent years consumers have been even more interested in the manner and procedures of food production. They want to know about the origin of meat they buy, and they choose the products according to their findings. Consumers are interested in whether the animals were treated in accordance with welfare during breeding, transport and processing, and they demand humane methods even more. A poll was conducted in the period from October to December in 2011 on the sample of 187 randomly selected examinees from the area of Sisak – Moslavina County, City of Zagreb County and Zagreb County. 45.5% of male and 54.5% of female examinees took part in the research. Similarly to the results of the researches conducted so far in Croatia, but also to the prevailing opinion in the EU countries, the majority of examinees in this research lists high concern for animal welfare. But, regardless of their concern, most of them don't take animal welfare into consideration when they buy meat. Sample size and the procedure of sampling in this research enable making some conclusions on Croatian meat consumers and their attitudes toward animal welfare. But, these researches are necessary to be repeated on a larger sample and the distribution of examinees through all the areas of the Republic of Croatia.*

***Keywords:*** *animal welfare, meat quality, consumers, poll*

## Introduction

Along with the development, progress and maturation of human civilization there appears empathy, not only towards other people, but towards animals too, including those which are used for food. Except for the welfare of animals which at some points becomes a goal in itself, we also become conscious of its influence to meat quality, taking into consideration health safety of the meat, as well as its sensory characteristics. In recent years consumers have become more interested in the manner and procedures of food production (Gade, 2002), they want to know about the origin of the meat they buy (Warriss and Brown, 2000), and they choose the productsaccording to these findings (Busquin, 2004).

Speaking of animal welfare, there is often forgotten the fact that it doesn't stop when an animal leaves the farm, but it should continue through the entire process of transport and processing. Therefore, animal welfare in general, but welfare of farm animals in slaughter line as well have been taking increasingly important role nowadays (Petak and Mikuš, 2011). The researches conducted in Great Britain have shown that 87% of the poll examinees were concerned for handling farm animals, i.e. whether they suffered in the process of meat production (Bennett, 1996). Consumers are interested in whether the animals were treated in accordance with welfare during breeding, transport and processing (Warriss and Brown, 2000) and they demand humane methods to be used (Appleby and Hughes, 1997).

[1] **Davorin Mijatović, DVM**;

[2] **Tomislav Mikuš, DVM**, Professional Associate; **Bela Njari, PhD**, Full Professor; **Željka Cvrtila Fleck, PhD**, Assistant Professor; **Lidija Kozačinski, PhD**, Full Professor; University of Zagreb, Veterinary Faculty, Department for Hygiene, Technology and Food safety, Heinzelova 55, Zagreb

[3] **Željka Mesić, M.Sc.**, Research Assistant, University of Zagreb, Faculty of Agriculture, Department for Marketing in Agriculture, Svetošimunska 25, Zagreb