Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 2, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EGG QUALITY RESEARCH ON CONTAMINATION IN VARIOUS SEASONAL CONDITIONS

Artur GOLBAN[1], RitaGOLBAN[2]

[1]Commercial Bank "Victoriabank" Joint Stock Company, Chisinau, 141, 31 August 1989 Street, MD-2004, Republic of Moldova, E-mail: aaartgolb@gmail.com
[2]Technical University of Moldova,168, Stefan cel Mare Boulevard, Chisinau, Republic of Moldova, MD-2004, E-mail: golbanrita@gmail.com

Corresponding author: aaartgolb@gmail.com

Abstract

The scientific research reflected in this study aimed to identify the quality of chicken eggs regarding bacterial contamination in different seasonal conditions. The scientific researches were performed using the following research methods: microscopic visualization, qualitative and quantitative analysis, induction, deduction, the graphics method, the chronological series method. The results of the research highlighted the general prevalence of microbial germs on the eggshell surface during the autumn season, followed by the spring season and finally a lower prevalence during the winter season. Salmonella species were not identified. In the scientific research are analysed the egg production per region, revenue in the egg market of Moldova, sales channels of eggs and egg quality in different seasonal conditions. In the same time the research finishes with conclusions/recommendations related the egg quality assurance and bacterioscopic results.

Key words**:** *hen eggs, bacteriology, bacterioscopy, egg shell, microflora*

INTRODUCTION

The production, processing and consumption of eggs and derived products has seen a constant increase in the last decades, and the obtaining and industrialization of eggs for consumption can be considered as some of the most dynamic activities in the agri-food chain, that is why the idea of increasing the shelf life of eggs and their superior valorization in correlation with consumer market preferences have become current and of particular importance [4, 10, 12].

Food safety, quality and taste are important attributes for both producers and consumers. The increased demand for food products with a long shelf life that maintain their nutritional and sensory characteristics has required the development of appropriate preservation methods. For consumers, the quality of food products is correlated with shelf life and sensory characteristics [2, 5, 8].

In order to meet the needs of the modern human factor in relation to the quantity and quality of food products, a sustained effort is required to increase agricultural and livestock production, for a higher consumption of natural products at the expense of processed ones [1, 3, 5].

Currently, worldwide, it can be observed that the scientific evolution of recent years has visibly influenced the way of life of the modern population. This is reflected in the daily diet, through the food consumed that is processed and concentrated, so that it is as easy as possible to cook but also to produce the feeling of satiety, but without taking into account the needs of the human body and the effects in the long term on his health [6, 7].

From this point of view, the main objective of this research is the investigation of the quality of some varieties of eggs in various seasonal conditions.

MATERIALS AND METHODS

The contamination research on egg quality was carried out on different varieties of hen's eggs sold at the market and store, in Chisinau municipality, in different periods of the commercialization season: autumn, winter, spring.

The investigations were carried out according to the laboratory methods regarding the

superficial investigation of the eggshell microflora. The researches were carried out in the presence of the characteristic indices of the total number of germs (NTG), pathogenic microorganisms frequently involved in the contamination of eggs, fungi and yeasts.
The development of microbial cultures on culture media and their study was carried out by native and microscopic visualization. During the laboratory research, bacterioscopic, bacteriological, organoleptic investigations were carried out, the morphology of the microscopic microorganisms was determined and their differentiation was resorted to according to laboratory methods regarding the quality of food products.
The research to highlight the quality of the eggs was carried out in accordance with the regulated requirements for the investigation of food products in the laboratory of microbiological investigations of food products within the Diagnostic Center in Veterinary Medicine in Chisinau.

RESULTS AND DISCUSSIONS

Production (growth) of animals (in live weight) in households of all categories in January-September 2023 compared to January-September 2022 decreased by 4.5%. The decrease in production was generated by the decrease in production in households (-5.5%) and in agricultural enterprises (-3.6%).
Despite the fact that milk production in agricultural enterprises increased by 16.0%, in households of all categories production decreased insignificantly - by 0.1% as a result of its decrease in households by 2.5%.
Egg production in households of all categories decreased by 3.3% due to the decrease in production in households by 9.0%. At the same time, egg production in agricultural enterprises increased by 5.2%.
Distribution of egg production by region in the Rpublic of Moldova in the year 2022 is presented in Figure 1.
Mostly, eggs are produced in household of the population, namely, in January-September, 2023, were produced 281.4 million pieces (56.5%) being followed by agricultural enterprises where were produced 216.6 million pieces (%).
According to Fig. 1, in 2022 the highest average annual production per region, was registered in North Region – 28%, being followed by Chisinau Municipality – 27%, after South Region 25% and Centre Region with 20%.

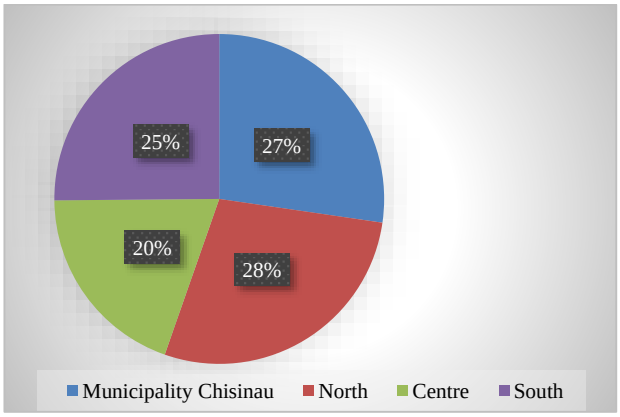

Fig. 1. Distribution of average annual production of eggs per region, Republic of Moldova, 2022
Source: elaborated by the author.

According to the data from Fig. 2, in 2023 the revenue in the eggs market of Moldova constituted 71.84 mln USD. The percent of market growing is expected to be 11.32% annually.

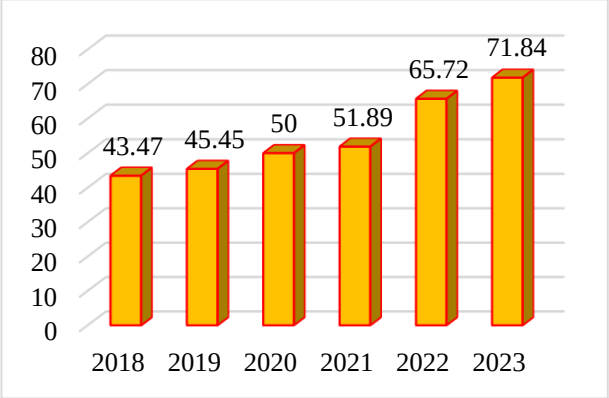

Fig. 2. Revenue in the eggs market of Moldova for 2018-2023, mln. USD
Source: elaborated by the author.

According to Figure 3, eggs are sold mostly offline. In 2023, 98.5% of eggs were sold offline and 1.5% of eggs were sold online.
Livestock production by main types in the period January-September 2023 is shown in Table 1.

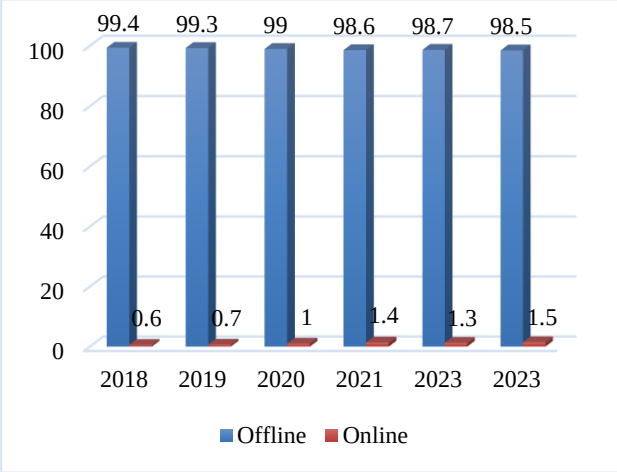

Fig. 3. Sales channels of eggs for the period 2018-2023
Source: elaborated by the author.

Table 1. Livestock production by main types in January-September 2023

	Total	**In % compared to January-September 2022**	**Share (in % of the total)**
Production (breeding) of animals			
(in live weight) – total, thousands of tons	**130.0**	**95.5**	**100.0**
out of which:			
-Agricultural enterprises	69.7	96.4	53.6
-Households of the population	60.3	94.5	46.4
Milk - total, thousands of tons	**221.4**	**99.9**	**100.0**
out of which:			
-Agricultural enterprises	33.4	116.0	15.1
-Households of the population	188.0	97.5	84.9
Eggs - total, million pieces	**498.0**	**96.7**	**100.0**
out of which:			
-Agricultural enterprises	**216.6**	**105.2**	**43.5**
-Households of the population	**281.4**	**91.0**	**56.5**

Source: adjusted by the author based on [9].

Based on the study of the quality of some egg assortments, regarding superficial contamination depending on the season, we allowed ourselves to appreciate them through the values obtained as a result of counting microbial colonies.

According to the bibliographic references, it is known that the superficial germs of the eggshell are often of faecal origin, bedding, machinery, etc.

These bacteria can represent saprophytic and pathogenic bacteria and are significant in egg quality evaluations.

The data from Figure 4 regarding the bacteriological investigations of the load of germs on the shell of chicken eggs studied under market conditions depending on the season determine a greater number of colonies in the autumn season-10, compared to the spring-4 and winter seasons- 2 colonies highlighted on agar medium. A higher number of colonies were recorded on Endo media in spring-3 colonies, compared to autumn-2 colonies and winter-1 colony. Regarding the Saburov environment, regarding the results obtained, colonies were registered in a larger quantity during the autumn season - 3 colonies, compared to the winter season - 1 colony and spring - 2 colonies.

These results confirm to us that the pollution of the eggshell surface shows higher values during the autumn season, which justifies data of more intense multiplication of pathogenic germs regarding the surface microflora of market eggs.

The results of bacteriological investigations of the load of germs on the shell of chicken eggs studied in store conditions, depending on the season, confirmed that in these food products the number of colonies compared to the research of eggs studied in market conditions is lower, constituting a number of 8 in autumn colonies on agar medium, compared to spring periods with 3 developing colonies and winter 1 microbial colony.

Microbiological investigations were also carried out on special media for the determination of mycete and E.coli microorganisms.

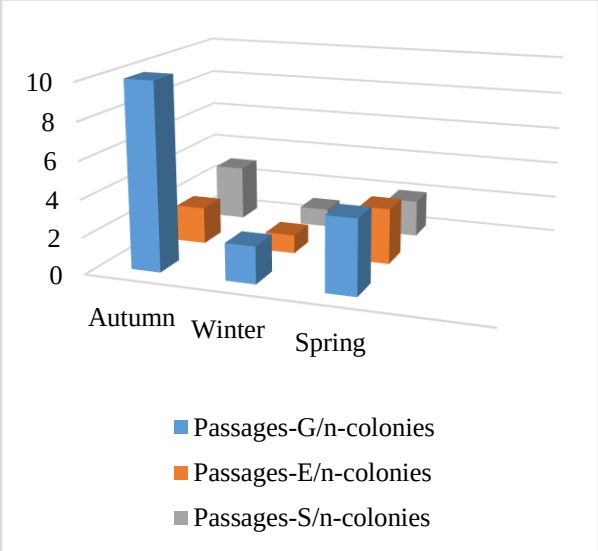

Fig. 4. Bacteriological investigations of the germ load on the shell of chicken eggs studied under seasonal market conditions
Source: elaborated by the author.

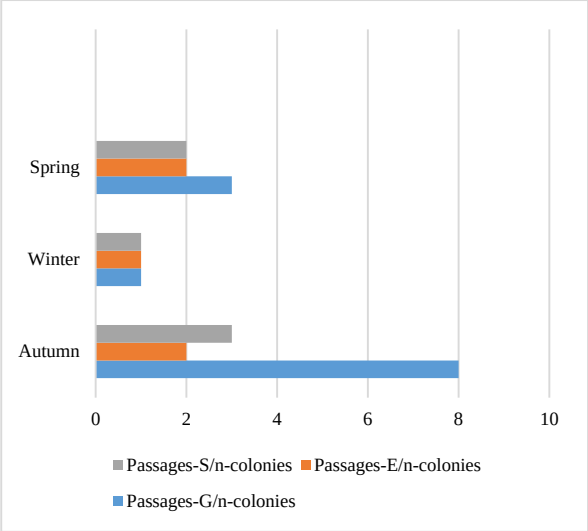

Fig. 5. Bacteriological investigations of the germ load on the shell of hen eggs studied under store conditions depending on the season
Source: elaborated by the author.

Values of 3 microbial colonies on the Saburov medium during the autumn season, 2 microbial colonies in the spring and 1 microbial colony in the winter season were determined. 2 microbial colonies were determined on the Endo medium in the fall, 2 microbial colonies in the spring and 1 microbial colony in the winter. Analyzing these values in a comparative aspect, we deduce that the shell of the eggs sold in the store is less contaminated with microorganisms. Therefore, the incidence of microorganisms on eggshell in this study was slightly lower than that of the eggs in the previous study, but the incidence on these eggs is not dangerous for sale.

Other research after microbiological laboratory conduct is reflected in Figure 5, where the results of the bacterioscopic determination of the load of germs on the shell of hen's eggs studied under market conditions depending on the season are shown. Bacterial load, where NTG/cocci are reflected, the number of yeasts present, etc. was determined. The bacterioscopic investigations were carried out by making smears from the microbial colonies, which were carried out on sterile slides and stained according to the Gram method, using gentian violet dyes, fuchsin, Lugol's solution, fixing with ethyl alcohol. Based on the bacterioscopy study, it was revealed under microscopy that the bacterial load of the eggshells in the fall constituted 42 eggs, compared to the period of spring, where the number of cocci was 35 cocci microbial cells and in winter, where this NTG index constituted a smaller amount corresponding to 10 cocci under microscopy.

The microbial species Salmonella was not identified on the eggshell surface. The bacterioscopic research of the shell of chicken eggs studied under market conditions revealed a number of 5 yeasts during the autumn season, compared to the spring season, where the number of yeast cells constituted 3 yeast cells and in the winter, where this number constituted 1 yeast cell. These reports infer the fact that the microbial contamination of the eggshell from a bacterioscopic point of view is higher in the fall, followed by the spring season and respectively at the end, a mixing of the number of cocci microorganisms is observed in the winter, regarding the contamination of the eggshell traded on the market.

The bacterioscopic study of the load of germs on the shell of chicken eggs studied in store conditions depending on the season shown in Figure 6 shows important aspects regarding this bacterial microflora shown by the number of yeasts, escherichia, NTG. Salmonella species is absent.

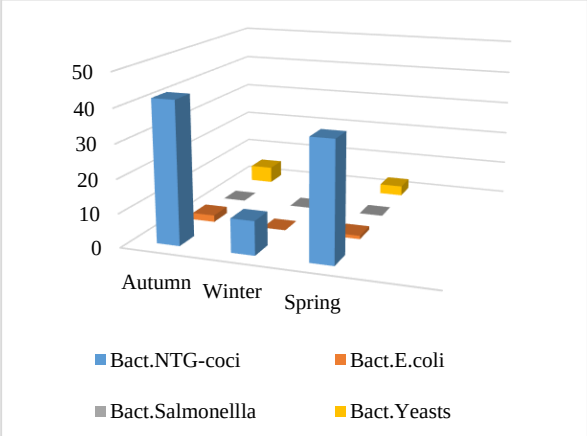

Fig. 6. Bacterioscopic investigations of the germ load on the shell of hen eggs studied under seasonal market conditions
Source: elaborated by the author.

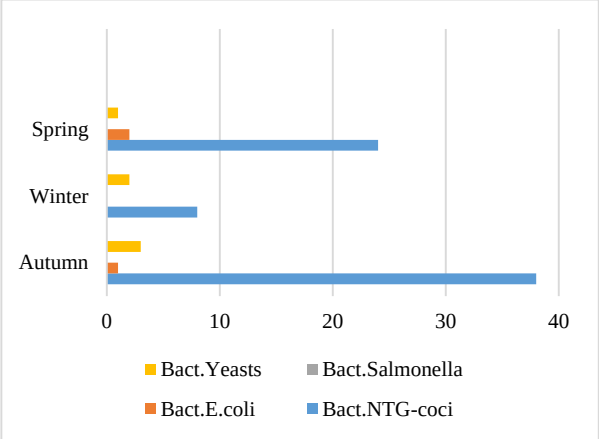

Fig.7. Bacterioscopic investigations of the germ load on the shell of chicken eggs studied under store conditions depending on the season
Source: elaborated by the author.

The values of Figure 7 reveal that the shell of the eggs sold in the store during the autumn season recorded 38 microbial cells, compared to the spring where 24 cocci microbial cells were microscopically observed and in the winter where the number of cocci cells showed 8 cocci.

The yeast cells presented a number of 3 cells during the autumn period, compared to the spring season - 1 cell and in the winter 2 microbial cells presented on the surface of the eggshell.

Therefore, the indices obtained reveal that the pollution of eggs sold in the store in various periods of the season presents lower quantitative aspects, compared to the indices obtained by microscopy as a result of investigations of the shell of eggs sold in market conditions in various periods of the season.

The quality of the evaluated eggshell presents, in our opinion, the development of a strategy to reduce the risk of pathogens from the outside, because the eggshell presents from a practical and scientific point of view a risk of the penetration of pathogenic species inside the eggs and at the same time offers a greater resistance good at penetration of pathogens and contamination of internal contents.

The National Agency for Food Safety (ANSA) warns consumers to purchase fresh eggs only from authorized places and in original packaging.

According to ANSA the eggs for human consumption are classified in the following quality categories:

a) category A or "fresh eggs";

b) category B which are delivered only to the food and non-food industry.

Category A eggs are classified according to the following weight categories:

a) XL – very large: at least 73 g;

b) L – large: from 63 to 73 g exclusively;

c) M – average: from 53 to 63 g exclusively;

d) S – small: less than 53 g.

Category A eggs must have the following quality characteristics:

a) whole, hard, uncracked, clean, matte, rough peel, without visible spots or pores;

b) cuticle: whole, clean, intact;

c) air chamber: the height should not exceed 6 millimeters, immovable; however, for eggs marketed with the mention "extra", it must not exceed 4 millimeters;

d) the yolk: visible in the light beam only in the form of a shadow, without a precise outline, without visibly moving away from the central position, in case of turning the egg;

e) white: clear, transparent;

f) without foreign bodies;

g) no foreign smells.

Category A eggs are not refrigerated in premises or installations where a temperature lower than 5°C is artificially maintained.

Eggs that have been kept for less than 24 hours at a temperature lower than 5°C, during a transport operation, or kept in the premises

where the retail sale is practiced or in its dependencies for maximum 72 hours.

Category A eggs bear the manufacturer's code and the laying date, they are classified, marked and packed within ten days of laying.

The minimum validity date is marked at the time of packaging and announced by the mention:

a) "to be consumed before...", if the date contains the indication of the day;

b) "to be consumed before the end...", in the other cases.

The consumption limit date cannot exceed 28 days from laying the eggs. If the laying period is indicated, the minimum validity date is established starting with the first day of the respective period.

On the packages containing category A eggs, until the ninth day after laying, the words "extra" or "extra fresh" can be used as additional quality indications. In this case, the laying date and the nine-day period appear on the packaging and are visible.

It is important not to forget that before consumption, eggs must be washed, because microorganisms harmful to health can enter food from the shell.

Details about the egg marking requirements are presented in Figure 8.

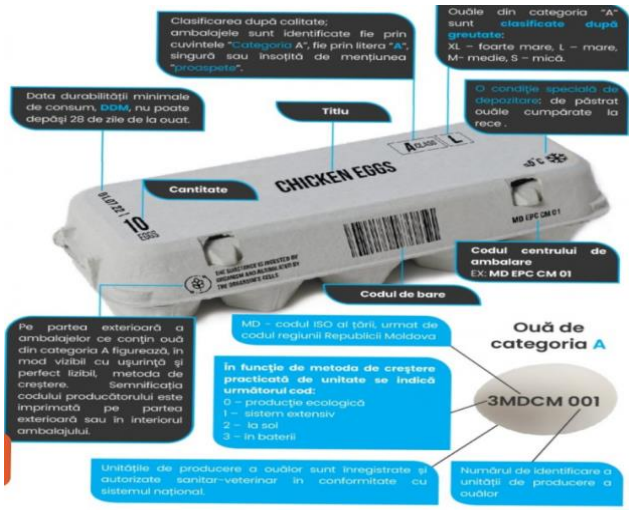

Fig. 8. Egg marking requirements
Source: [11].

CONCLUSIONS

Bacteriological investigations of the load of germs on the shell of eggs sold in market and store conditions in various periods of the season determined values of the number of colonies between 8-10/autumn; 3-4/spring and 1-2/winter.

The bacterioscopic evaluations of the total number of germs investigated on the surface of the eggshell revealed values of the number of shells between 38-42/autumn; 24-35/spring and 8-10/winter.

The research results in the conducted study demonstrated the general prevalence of microbial germs on the eggshell surface during the autumn season, followed by the spring season and finally a lower prevalence during the winter season. Salmonella species were not identified.

REFERENCES

[1]Banu, C., 2010, Food Industry Treaty. ASAB Publishing House, p.68.

[2]Băisan, I., 2015, Operations and technologies in the food industry: course for students majoring in machines and installations for agriculture and the food industry. Technical University „Gh. Asachi", Iaşi, 365 p.

[3]Carp-Cărare, C., 2014, General Microbiology. Iaşi: Ion Ionescu de la Brad Publishing House, 245 p.

[4]Dan, V., 2001, Food microbiology. Alma Publishing House, Galați, p. 52.

[5]Forbes, B. A., Sahm, D.F., Weisfeld, A.S., 2007. Laboratory methods in basic mycology. In: Bailey and Scott's Diagnostic Microbiology, 12th ed., 629-716.

[6]Guguianu, E., 2002, General bacteriology (Bacteriologie generală). In Romanian. Jenus Publishing House, Iași, 206 p.

[7]Moldovan, R. et al., 2013, Practical works of Microbiology, Victor Babes Publishing House, Timisoara.

[8]Murray, P.R., Baron, E.J., Jorgensen, J.H., Landry, M.L., Pfaller, M.A., 2007, Manual of Clinical Microbiology. 9th ed. 2007,1728-1737.

[9]National Bureau of Statistics of the Republic of Moldova, https://statistica.gov.md/ro/activitatea-agricola-in-ianuarie-septembrie-20239515_60769.html, Accessed on April 10, 2024.

[10]Oprean, L., 2002, Microbiology of food products. Vol. 2, „Lucian Blaga" University Publishing House, Sibiu, pp. 78-94.

[11]PRO.TV Chisinau, 2022, La ce ar trebui sa fie atenti consumatorii cand cumpara oua de gaina (To what consumers have to pay attention when they but hen eggs), https://protv.md/actualitate/la-ce-ar-trebui-sa-fie-atenti-consumatorii-atunci-cand-cumpara-oua-de-gaina-ansa-vine-cu-explicatii-foto---2625587.html Accessed on April 10, 2024.

[12]Tașbac, B., 2017, Special veterinary bacteriology. Larisa Publishing House, Câmpulung. 284 p.