



THE UNION OF ENTREPRENEURS  
AND EMPLOYERS

SALMONELLA  
IN FLOCKS OF LAYING  
HENS (*GALLUS GALLUS*  
*DOMESTICUS*) –  
OCCURRENCE,  
COSTS, AND  
PREVENTION IN POLAND

DECEMBER 2020

## SPIS TREŚCI

<b>INTRODUCTION .....</b>	<b>3</b>
<b>SUMMARY .....</b>	<b>4</b>
<b>INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND .....</b>	<b>5</b>
PRODUCTION, EXPORT, AND CONSUMPTION OF EGGS.....	6
POPULATION OF LAYING HENS IN POLAND .....	7
CHALLENGES SHAPING THE DEVELOPMENT OF THE EGG PRODUCTION INDUSTRY IN POLAND .....	8
Increase in salmonellosis rates .....	8
International threat to polish eggs export .....	9
Freshness, quality and safety as well as the price of eggs are the most important for consumers in the EU .....	9
Changing culinary trends – popular consumption of non-heat treated eggs .....	9
Free range rearing systems .....	10
Restriction of antibiotic use in poultry .....	11
<b>OCCURRENCE AND PREVENTION OF SALMONELLA .....</b>	<b>12</b>
SALMONELLA – THE BACTERIA .....	12
SALMONELLOSIS IS A ZONOSIS - A DISEASE THAT IS TRANSMITTED FROM ANIMALS TO HUMANS .....	12
INCREASED INCIDENCE OF SALMONELLOSIS IN POLAND .....	13
ROUTES OF INFECTION OF POULTRY WITH SALMONELLA .....	14
ACCEPTABLE FREQUENCY OF SALMONELLA INFECTION IN COMMERCIAL FLOCKS OF LAYING HENS IN INDIVIDUAL EU COUNTRIES .....	15
THE PRESENCE OF SALMONELLA IN FLOCKS OF LAYING HENS AND THE ONSET OF SALMONELLOSIS IN HUMANS .....	16
SALMONELLA PREVENTION IS CARRIED OUT ON MANY FRONTS .....	16
Example of Belgium .....	19
Example of Hungary.....	19
OUTCOMES OF THE IMPLEMENTATION OF THE NATIONAL PROGRAMME FOR THE CONTROL OF CERTAIN SALMONELLA SEROTYPES IN LAYING FLOCKS OF HENS (GALLUS GALLUS DOMESTICUS) IN POLAND.....	20
<b>ECONOMY OF THE SALMONELLA PROBLEM .....</b>	<b>23</b>
COSTS OF SALMONELLOSIS.....	23
Costs of salmonellosis on the side of the healthcare system and social costs:.....	23
Salmonellosis costs incurred by breeders and producers:.....	23
Other costs include:.....	23
RISK OF LIMITING OR LOSING INTERNATIONAL EGG EXPORT MARKETS FROM POLAND DUE TO THE RISK OF INFECTION WITH SALMONELLA .....	24
CALCULATION OF THE COST OF VACCINATION OF COMMERCIAL LAYING HENS AGAINST SALMONELLA IN POLAND .....	26
<b>RECOMMENDATIONS .....</b>	<b>28</b>

## INTRODUCTION

---

### INTRODUCTION

Zoonoses have always posed a significant threat to human health and life.

The COVID-19 disease pandemic caused by SARS-CoV-2 coronavirus is another example in worlds' history that has clearly showed the close relationships between human and animal health.

Salmonellosis is a bacterial disease that affects birds, animals and humans. It is caused by a common and resistant to destruction *Salmonella* bacteria. Salmonellosis in humans is one of the most common and economically most expensive zoonoses.

The presented report describes the current scale and the economic, social and political importance of the *Salmonella* occurrence in commercial flocks of laying hens in Poland, shown against the background of other European Union countries.

The report discusses the effects of insufficient preventive and control measures taken to reduce the number of commercial flocks of laying hens infected with this bacterium. Effective and, more importantly, economically justified solutions to improve the current epizootic situation associated with *Salmonella* infections in Poland have also been proposed. Taking these measures will allow Poland to remain one of the important and reliable producers and exporters of chicken eggs in Europe and globally.

## SUMMARY

---

### SUMMARY

1. Egg production is an important sector of Polish agriculture. Poland is one of the largest egg producers in the EU (512 thousand tonnes per year), of which over 40% of domestic production is exported abroad. Egg export is extremely important for the Polish economy also due to the significantly lower average egg consumption in Poland than in other countries (160 eggs / person per year vs. 235 eggs / person per year in Germany).
2. *Salmonella* is a difficult to eradicate bacterium, primarily dangerous to human and animal health, occurring in flocks of laying hens and causing significant economic losses.
3. For years, Poland has not met the EU guidelines regarding the level of prevalence of *Salmonella* in laying hens (currently acceptable in the EU 2% of infected flocks, changing into 1% in the near future), estimated currently as about 4.5%.
4. In Poland, a large number of *Salmonella* human infections have been reported for several years - about 10,000 cases per year.
5. The total cost of the national programme for the control of *Salmonella* in laying flocks since 2008 is estimated at PLN 490 million. At the same time, despite such large costs, this programme is ineffective, and EU requested *Salmonella* prevalence levels are still not reached in Poland.
6. Immediate and multi-directional action should be taken as soon as possible to control against *Salmonella* infection: strong biosecurity and monitoring of farms at every stage of poultry production cycle; production of chicks free from infections, the care for poultry gastrointestinal tract health, avoiding feed infections; eliminating *Salmonella* from the environment (disinfection of poultry buildings and means of transport), and above all, it is necessary to introduce the obligation of preventive vaccination giving measurable positive results as in most European Union countries.
7. A subsidy from the state budget at the level of 50% for the costs of the vaccine for *Salmonella typhimurium* (ST) and *Salmonella enteritidis* (SE) in laying hens in Poland would amount to approx. PLN 10 million per year. The expected effects in the form of reducing the level of *Salmonella* infection (at least up to the level of 2% required by the EU), as well as the reduction of salmonellosis in humans and improvement of the quality and image of Polish eggs globally would bring economic benefits much higher than potential state subsidies.

## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

### INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

Egg production in Poland is one of the most important branches of the agriculture sector, which brings the country significant profits, especially from exports.

**Table.** Geographical structure of Polish eggs for consumption exports in 2018

Country	Tonnes (x1,000)
The Netherlands	56 137,2
Germany	51 643,8
Italy	14 835,0
The Czech Republic	12 714,5
Belgium	9 227,3
France	8 452,7
Hungary	8 007,4
The United Kingdom	6 607,1
Romania	6 017,0
Austria	5 563,1
Lithuania	5 536,8
Bulgaria	3 291,9
Croatia	2 317,7
Estonia	1 624,8
Spain	1 291,7
Latvia	1 062,2
Denmark	1 002,9
Slovakia	967,7
Greece	869,5
Switzerland	547,2
Saudi Arabia	498,0
Hong Kong	339,1
Cyprus	252,9
Slovenia	136,3
Sweden	115,0
Oman	104,8
Luxembourg	14,7
Iraq	80,8
Ireland	59,3
Bahrain	26,2
Norway	0,4
Antarctica	0,4
<b>SUMA</b>	<b>199 435,51</b>

Source: KIPDIP - <https://kipdip.org.pl/pl/news/wyniki-polskiego-eksportu-jaj-konsumpcyjnych-w-2018-roku>

## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

### PRODUCTION, EXPORT, AND CONSUMPTION OF EGGS

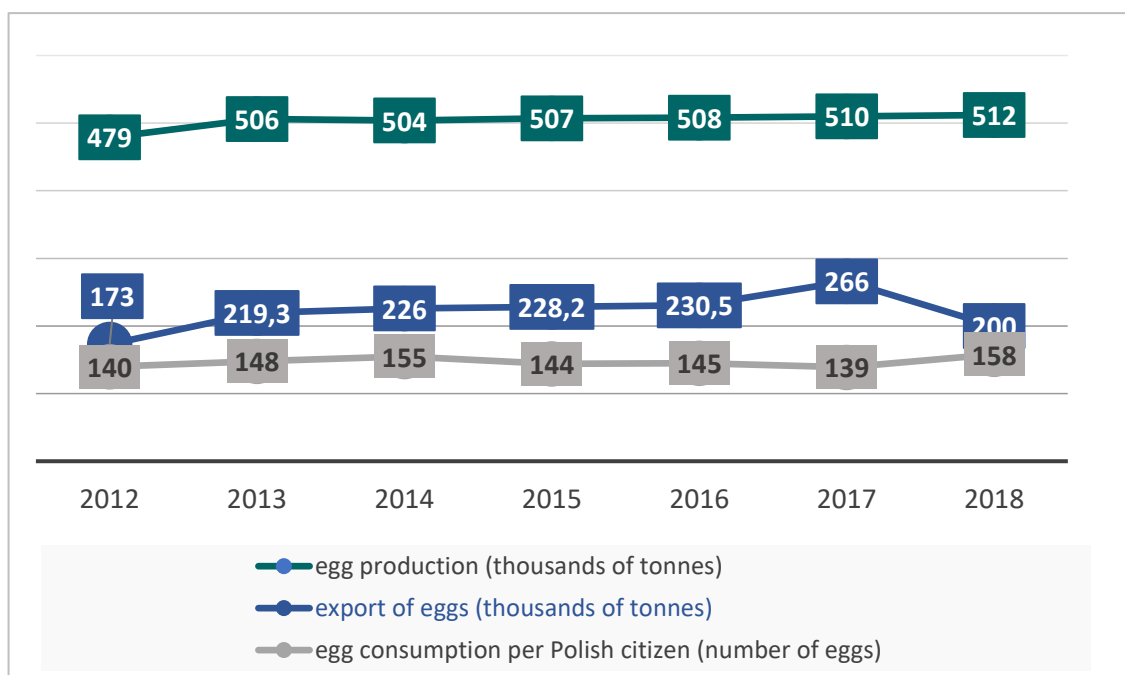
In Poland, over 9.2 billion eggs for consumption are produced annually (i.e. about 512 thousand tonnes), of which about 40% goes to foreign markets (about 205 thousand tonnes).

For several years, Poland has been one of “the seven” – a member of the group of the largest producers of eggs for consumption: the United Kingdom, Spain, Germany, Italy and France being production leaders. The Netherlands came ahead of Poland. The share of the supply of eggs from Polish farms in the total EU production currently accounts for 8.5%, i.e. around 200,000 tonnes of eggs for consumption.

Demand in EU countries is still a pillar of Polish eggs exports. Polish companies sold the most eggs to the Netherlands, Germany and Italy. The share of sales to third countries in the total export volume did not exceed one percent. At the same time, this does not exclude our presence outside Europe, thanks to the re-export of Polish goods by European traders.

In 2018, Polish companies clearly revived trade relations outside the EU customs area. Eggs were regularly sold to Saudi Arabia, while often to Hongkong, Oman, Bahrain and Iraq (Market Analysis, Institute of Agricultural and Food Economics: 2019).

**Fig.** Consumption eggs production sector in Poland (2012-2018)



## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

Egg export is extremely important for the Polish economy, because in Poland egg consumption is much lower than in other countries. Poles consume about 160 eggs a year. This is one of the lowest rates in the world. The French and Italians eat on average 215 eggs a year, while the Germans eat about 235 of them. The leader in egg consumption per year per capita is Mexico with an average consumption of 370 eggs per person per year.

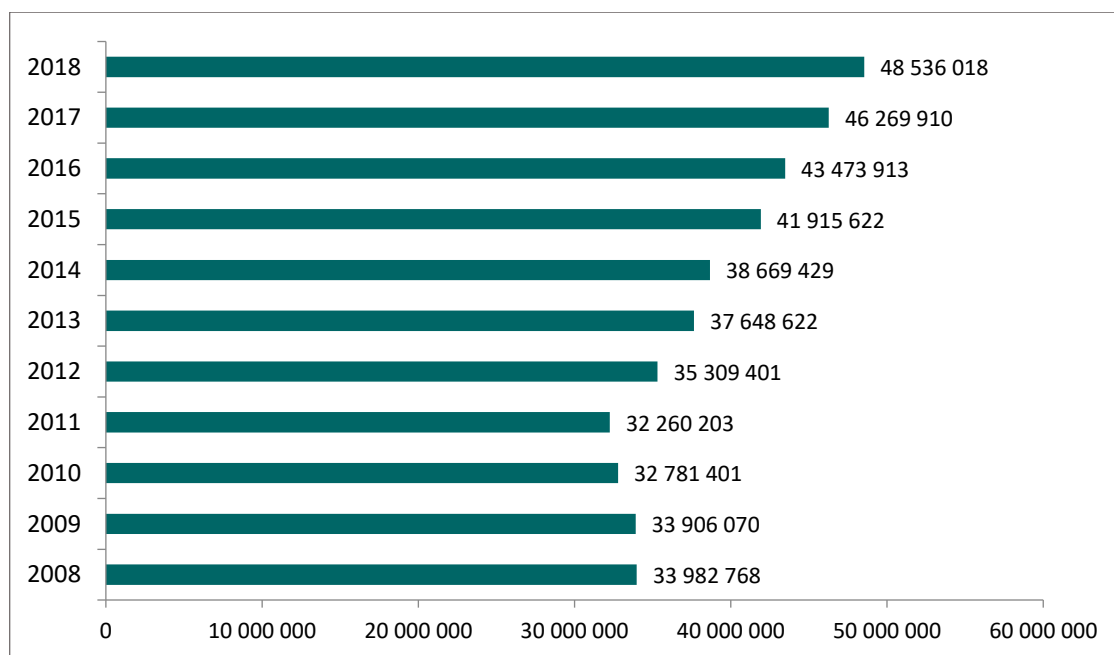
### CONCLUSION 1

**Due to the high production and low consumption of eggs in the country, Polish producers base their profitability on exporting the product from Poland.**

## POPULATION OF LAYING HENS IN POLAND

The number of laying hens in Poland has been steadily growing for several years. In 2018, it reached 48,536,018, while it increased to over 49 million in 2019. There are currently around 850 farms registered in Poland keeping over 1000 laying hens. However, only 5-6 large integrated enterprises holds the largest market share by producing a significant percentage of the total egg supply in the country. Of these, 84.5% of chickens are kept in a cage system, although egg production from alternative systems is increasing.

**Fig.** Total stock of laying hens in Poland



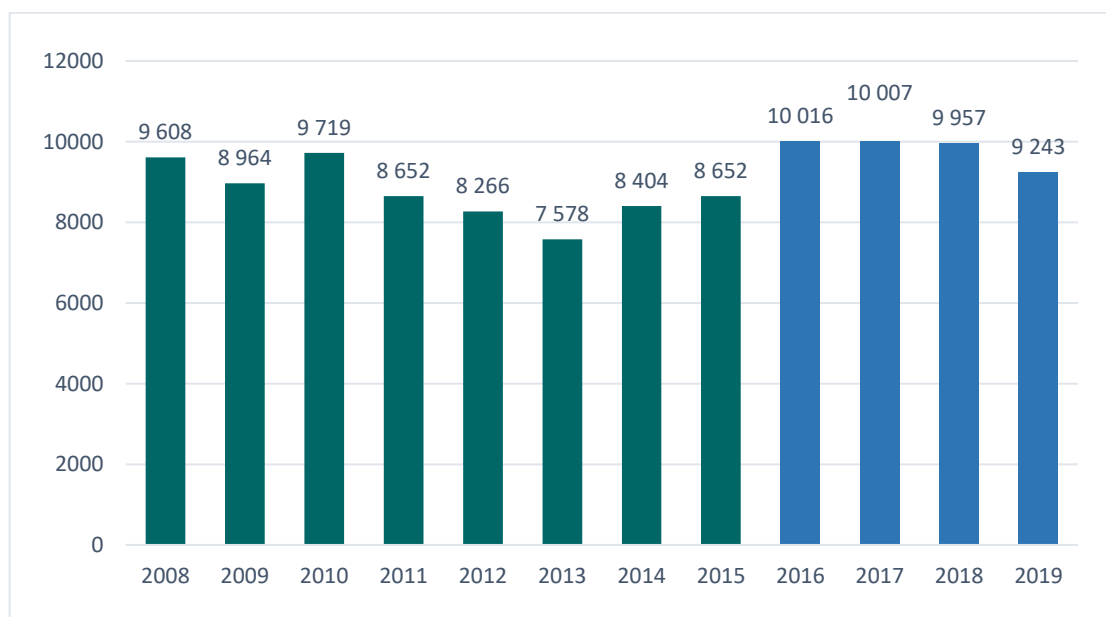
## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

### CHALLENGES SHAPING THE DEVELOPMENT OF THE EGG PRODUCTION INDUSTRY IN POLAND

#### Increase in salmonellosis rates

In the European Union, there has been a clear upward trend in salmonellosis since 2015, unlike 2008-2014 (European Food Safety Authority - EFSA report<sup>1</sup>). Unfortunately, cases of salmonellosis originating from Poland are largely responsible for this increase. In 2017 and 2018, there were more than 10,000 cases of human salmonellosis per year in our country, most of these incidents were caused by eggs. In turn, based on data from the European RASFF system (Rapid Alert System of Food and Feed), almost 45% of all reports regarding *Salmonella* were recorded in products originating in Poland. Given the sanitary and epidemiological safety and the image of the Polish egg production sector, this is a very worrying and undesirable phenomenon.

**Fig.** Liczba Incidence of salmonellosis in Poland by 31st December 2019 (data: number of cases and incidence per 100,000 population)



Source: Department of Infectious Disease Epidemiology and Surveillance NIZP-PZH Department of Anti-Epidemic and Sanitary Protection of GIS Borders

<sup>1</sup> EFSA (European Food Safety Authority) and ECDC (European Centre for Disease Prevention and Control), 2015. The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2014. EFSA Journal 2015;13(12):4329, 190 pp. doi:10.2903/j.efsa.2015.4329



## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

---

### **International threat to polish eggs export**

In recent years, one can notice a large development of the Ukrainian egg production sector. Ukraine has reached as much as 10% share in European egg imports, while the increase in imports from our eastern neighbour to the EU increased by 65% every year. This is mainly due to Ukraine's low production costs. At present, the barrier to even more intensive exports is the low veterinary and sanitary standard of Ukrainian eggs, reported to the European Commission by EU member states (e.g. confirmed fears of the Latvian nutrition and veterinary services (PVD) reported to DG SANTE regarding four RASFF notifications (Rapid Alert System) regarding *Salmonella* in egg products imported from the Ukrainian company Ovostar Ltd. (April 2019) or the withdrawal of Ukrainian eggs from the Israeli market in 2016 due to their infection with SE. In this context, maintaining competitiveness is extremely important for the Polish economy, making efforts to ensure that Polish eggs are of good quality and safety. This will allow Poland to maintain a good position on the European market, despite the growing competition<sup>2</sup>.

### **Freshness, quality and safety as well as the price of eggs are the most important for consumers in the EU**

Egg consumers are not a homogeneous group of customers. The vast majority of buyers are people who primarily take into account freshness, quality and price of eggs. Trust in the producer and distributor of eggs is important. Maintaining a good product brand is necessary to maintain a stable market position. Even the smallest quality deficiencies, in the era of quick information and high competition, may prove disastrous for the producer and weaken the position on the market for a long time, which in turn may affect the image of the country of origin of eggs that do not meet such requirements.

### **Changing culinary trends – popular consumption of non-heat treated eggs**

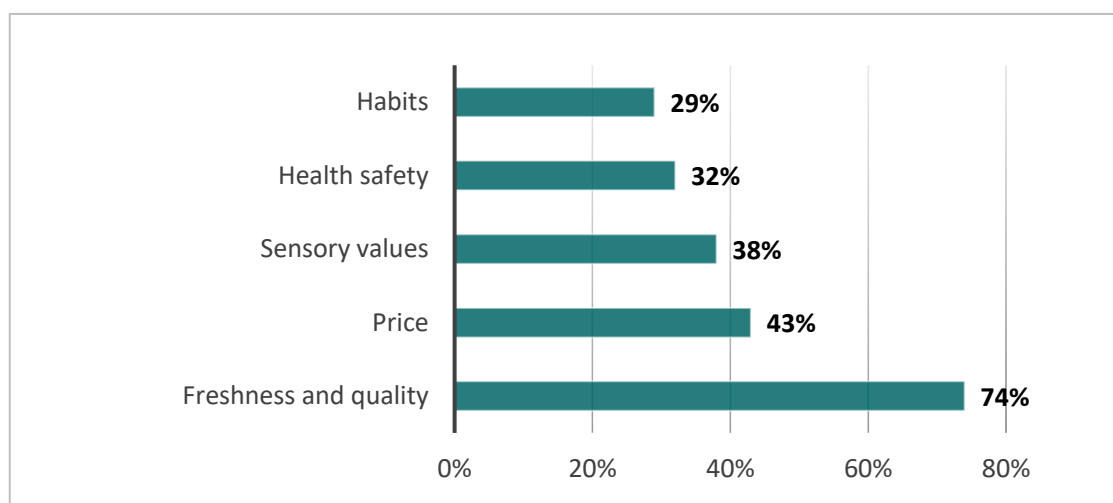
One of the diets that have recently become popular is "raw food", which includes consumption of raw products, unheated above 40°C. The "raw" diet has more and more supporters, also in Poland (e.g. Vienna-style eggs, or eggs Benedict). Most often it is combined with a vegetarian or vegan diet, although some proponents also consume animal products raw. The concept of this type of nutrition is based on the assumption that skipping heat treatment preserves naturally occurring enzymes. In the case of children and adolescents, it becomes problematic to provide the right amount of protein, because legumes should not be eaten raw. Therefore, consumers use raw eggs. This trend clearly increases the pressure and responsibility of egg producers to keep their products safe and free from *Salmonella*

---

<sup>2</sup> National Chamber of Poultry and Feed Producers (analyses, comments, forecasts): 2019: Market Analysis, Institute of Agricultural and Food Economics: 2019

## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

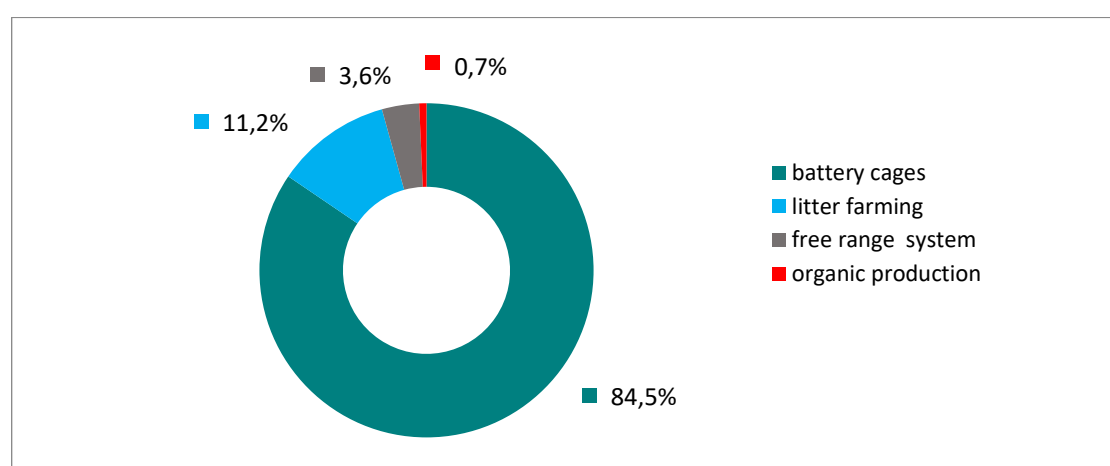
**Fig.** Factor affecting consumers food selection



### Free range rearing systems

The global trend of abandoning the sale and use of eggs from caged hens has reached the largest discount chains and food producers in Poland. In 2018, the production potential in this category (including litter, free range and organic egg production) reached over 7.2 million laying hens. In 2008, the capacity in alternative production systems did not exceed two million. It should be emphasised that the number of eggs in organic production (which requires the almost complete elimination of the use of chemicals and conventional veterinary medicines) more than doubled, from 152,000 hens in 2017, up to 324,000, in 2018. This causes difficult control over the health of poultry flocks kept in this type of production system. The process of withdrawal from the use and distribution of eggs “3” (battery cage eggs) will end in 2025 according to declarations of food wholesalers.

**Fig. 5.** Laying hen production systems in Poland (2018)



## INTRODUCTION - EGG PRODUCTION SECTOR IN POLAND

---

There is a low awareness among consumers that free-range egg production is associated with an increased risk of microbial infection, the presence of heavy metals and dioxins in eggs, and the increased spread of *Salmonella* in poultry. A significant threat is contact with wild birds, droppings and dangerous substances present in the environment, and microbial contamination of the eggshell, which reduces the hygienic quality of the product.

### **Restriction of antibiotic use in poultry**

Over 60% of *Salmonella* strains are resistant to available antibiotics. In 2017, the World Health Organization (WHO) issued recommendations on limiting the mass use of human-critical antibiotics in livestock. This is to prevent the growing resistance to antibiotics and to protect the effectiveness of antibiotics important for humans by limiting their unjustified use in animals, e.g. in the EU the treatment of salmonellosis in poultry flocks with the use of antibiotics is forbidden. On the one hand such treatment does not have a positive effect, and on the other - it increases antibiotic resistance. Unless special measures are taken to limit the occurrence of *Salmonella*, the scale of this phenomenon will increase. Cases of illness will be more frequent, and it will be more difficult to cure them. This is an urgent public health problem that needs to be addressed

### **CONCLUSION 2**

**The prerequisite for eggs export from Poland is their quality and safety for the health of consumers, i.e. mainly the absence of *Salmonella* infections.**

## OCCURRENCE AND PREVENTION OF SALMONELLA

# OCCURRENCE AND PREVENTION OF SALMONELLA

**Consumers are exposed to salmonellosis by consuming animal products: eggs, milk or meat infected with *Salmonella*.**

## SALMONELLA – THE BACTERIA

*Salmonella* is part of the intestinal microbiome of poultry, which balance can be disturbed by various factors: decrease in immunity, veterinary treatment, pressure of the environment, and then it can become a threat to animal and human health.

Bacteria from the genus *Salmonella* spp. belong to the family of *Enterobacteriaceae*. *Salmonella* spp. are gram-negative or anaerobic. Among the bacterial most frequently occurring serotypes are: *S. enteritidis*, *S. typhimurium*, monophasic *S. typhimurium* (very resistant multi-drug phenomenon is observed among bacteria of this strain), *S. Virchow*, *S. Hadar* – bacteria causing inflammation of the small and large intestine. They are also responsible for most bacterial food poisoning. In addition, *S. Typhi* – causes typhoid fever is distinguished, and *S. Paratyphi* – typhoid fever.



Salmonella is very resistant to environmental factors:

- These bacteria are only sensitive to high temperatures and die above 70 °C.
- They are relatively insensitive to the acidity of the environment – they remain viable within pH 4.0-9.5.
- Salmonella cells are extremely resistant to drying.
- Salmonella is a bacterium that shows high resistance to antimicrobial veterinary medicines. Salmonella strains exhibit high levels of resistance to ampicillin, sulfamethoxazole and tetracycline. In the case of monophasic *S. Typhimurium*, this percentage reaches even 100% (Wieczorek and Osek, 2017).

## SALMONELLOSIS IS A ZONOSIS - A DISEASE THAT IS TRANSMITTED FROM ANIMALS TO HUMANS

For humans, *Salmonella* bacteria pose a very high threat, even they can be fatal. As many as 95% of infections happens by eating eggs – especially raw, poultry meat, unpasteurised milk and its products. Less often, infections are caused by the direct

## OCCURRENCE AND PREVENTION OF SALMONELLA

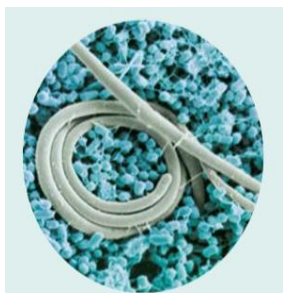
contact with animals or a sick person. Salmonellosis is in most cases characterised by an acute course. It is manifested by fever, stomachache, diarrhoea, nausea and vomiting. Very quickly it can lead to dehydration. Often, infected people require treatment in a hospital. The first symptoms of the disease occur 6-72 hours (usually 12-36 hours) after ingestion of *Salmonella*, and the disease lasts 2-7 days. Special groups exposed to the negative effects of infection are children, the elderly, as well as people with immunological deficiencies.

According to a report by the European Food Safety Authority in 2018, as many as one in three food-borne epidemics were caused by *Salmonella*. Salmonellosis was the second most commonly reported gastrointestinal infection in humans in the EU in 2018 (91,857 cases reported), after campylobacteriosis (The European Union One Health 2018 Zoonoses Report)

According to the CDC, there are over 2,000 different *Salmonella* serovars. Of these, *Salmonella typhimurium* (ST) and *Salmonella enteritidis* (SE) are the cause of more than 70% of human salmonellosis cases, **which is why their control in laying flocks has become crucial.**

### ***Salmonella enteritidis* (SE)**

is the most common type of *Salmonella*. In the European Union, *SE* causes about 44% of human salmonellosis.



The incidence of ***Salmonella typhimurium* (ST)** is increasing. In the European Union, *ST* is responsible for over 27% of salmonellosis in humans, but in some countries, such as Italy, it accounts for more than half of infections. *ST* can be transmitted to eggs of laying hens just like *SE*.



## INCREASED INCIDENCE OF SALMONELLOSIS IN POLAND

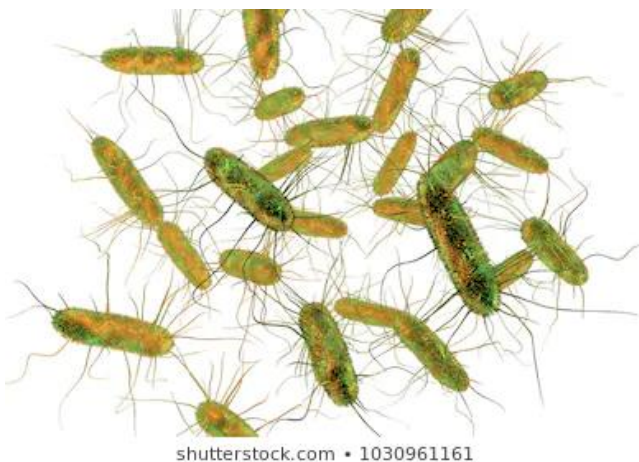
Due to the increased level of *Salmonella* occurrence in flocks of laying hens, the number of cases of salmonellosis among people in Poland has been dangerously high for two years. According to the data of the National Institute of Public Health – National Institute of Hygiene, in 2016 an increase in incidence by 16% (1,016 cases) was recorded, the most since 2007. Unfortunately, the increased number of reported

## OCCURRENCE AND PREVENTION OF SALMONELLA

---

cases of salmonellosis has remained to date. The high level of *Salmonella* prevalence in Poland is also confirmed by EFSA reports (The European Union One Health 2018 Zoonoses Report). In 2018, Poland found itself in an infamous group of countries (Poland, Spain and Slovakia) in which as many as 67% of all salmonellosis cases in the EU were directly related to eggs.

In the years 2012 - 2018, 1,500 people got poisoned with *Salmonella* from Polish eggs, based on the data from 18 countries. The European Centre for Disease Prevention and Control (ECDC) stated that most cases were reported during the summer months. The epidemic covered 15 countries including Belgium, the Czech Republic, Denmark, France, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland Slovenia, Sweden Great Britain Croatia and Finland.



The literature also contains information on the risk of developing Salmonellosis by tourists in EU countries. Unfortunately, Poland has a high risk factor, which is 100,000. tourists is 76.5. For example, in France this ratio is several times lower and amounts to 8.4, while in Finland 0.4 (based on an article from scientific journal Food Safety). Therefore, the increase in salmonellosis in Poland affects not only the image of the animal production and food industry sectors, but also more broadly - the image of the country.

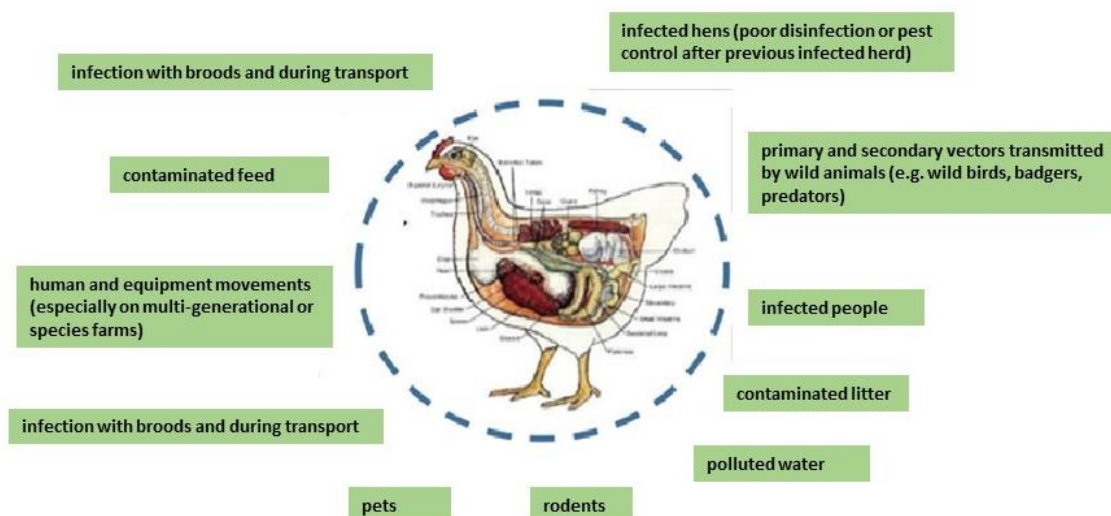
### ROUTES OF INFECTION OF POULTRY WITH SALMONELLA

Poultry is most often infected through the gastrointestinal tract, and the source of infection is usually compound feed not sufficiently heat treated or secondary contaminated with their final products. Another source of infection is the environment: contaminated litter, dust in the ventilation system, equipment, water, service, rodents, dirt, means of transport, etc.

*Salmonella* can be transmitted both by vertical (vertical) infection, i.e. from the parent flock to offspring, as well as by horizontal (horizontal) infection, from the contaminated environment to poultry. A vertical infection, from parent herd to freight, has been observed for the two main *Salmonella* serotypes, *Salmonella enteritidis* and *Salmonella typhimurium*.



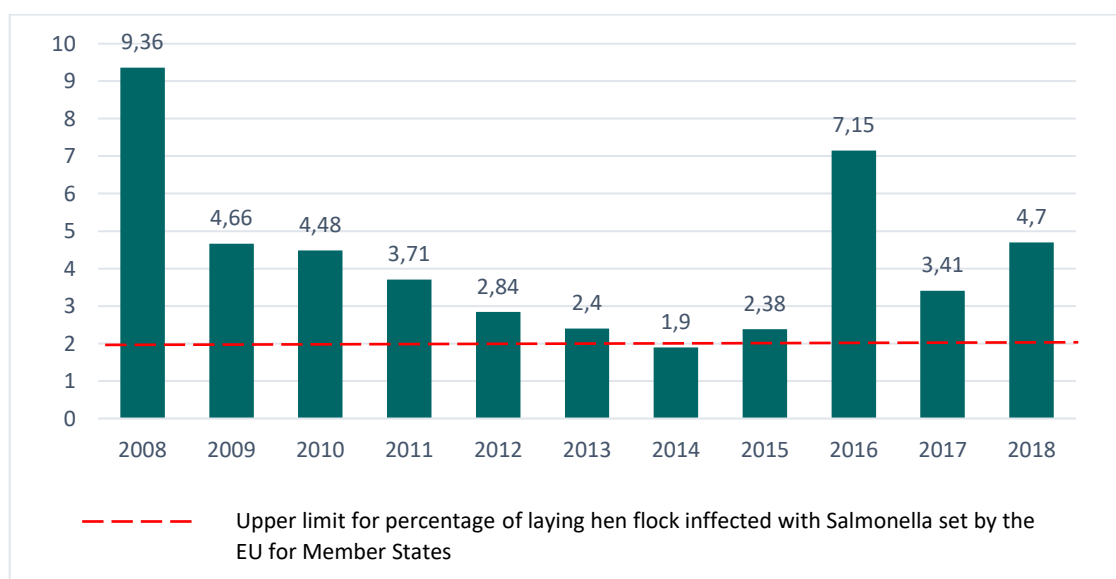
## OCCURRENCE AND PREVENTION OF SALMONELLA



### ACCEPTABLE FREQUENCY OF SALMONELLA INFECTION IN COMMERCIAL FLOCKS OF LAYING HENS IN INDIVIDUAL EU COUNTRIES

In accordance with EC Regulation No. 2160/2003 An EU target was set to limit the prevalence of *Salmonella* Enteritidis and *Salmonella* Typhimurium in flocks of adult commercial laying hens at 2% of all flocks in a given Member State. Currently, in almost all EU countries, the level of infection in laying flocks of laying hens does not exceed 2% (based on the report of the European Food Safety Authority (EFSA), January 20192). In Poland, however, since 2014 *Salmonella* levels have significantly exceeded the 2% required by EU law, and at present these levels are much higher than acceptable

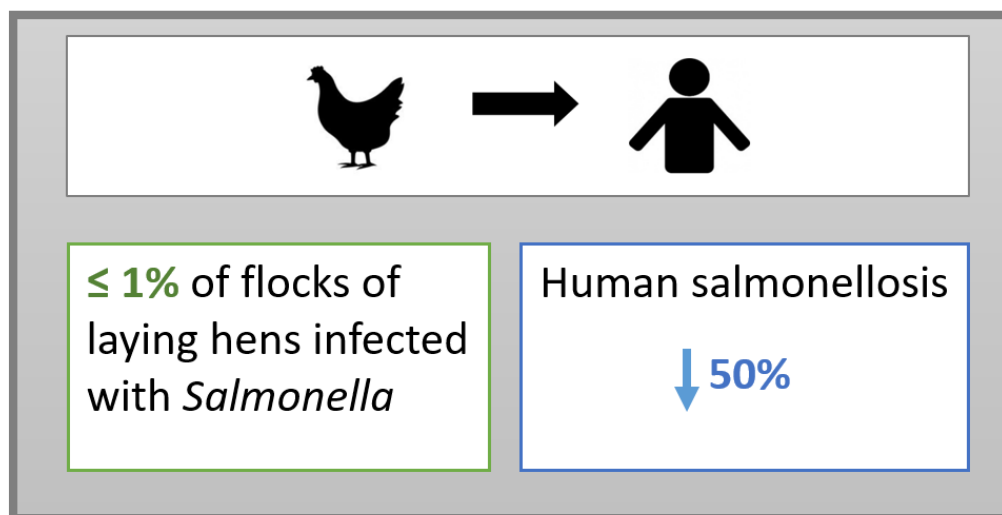
**Fig.** Percentage of adult flocks infected with *Salmonella* in Poland (2008-2018).



## OCCURRENCE AND PREVENTION OF SALMONELLA

### THE PRESENCE OF SALMONELLA IN FLOCKS OF LAYING HENS AND THE ONSET OF SALMONELLOSIS IN HUMANS

EFSA experts estimate that if *Salmonella* levels in laying hen flocks were reduced to 1%, human cases of salmonellosis transmitted by laying hens would fall by 50% (EFSA, 2019).



The pressure to reduce the level of *Salmonella* infection will increase because it is already said that in the future EU countries will be obliged to reduce the percentage of laying flocks infected with certain types of *Salmonella* to 1% - already achieved in some countries e.g. Denmark, Finland or Austria (on based on the European Food Safety Authority (EFSA) report <sup>3</sup>). The European Union and EFSA also recommend the development and implementation of new strategies to combat bacterial diseases that would limit antibiotic therapy and prevent the spread of antibiotic-resistant bacteria in animal and human populations. It also encourages increasing the share of existing methods of combating infectious diseases, such as preventive vaccinations, which would eliminate infections.

### SALMONELLA PREVENTION IS CARRIED OUT ON MANY FRONTS

Effective management and biosecurity systems can significantly reduce the risk of introduction and occurrence of *Salmonella* infection. Every country in the EU must have a national *Salmonella* control programme (National Control Programme – NCP).

<sup>3</sup> EFSA BIOHAZ Panel (EFSA Panel on Biological Hazards), Koutsoumanis K, Allende A, Alvarez-Ordóñez A, Bolton D, Bover-Cid S, Chemaly M, De Cesare A, Herman L, Hilbert F, Lindqvist R, Nauta M, Peixe L, Ru G, Simmons M, Skandamis P, Suffredini E, Dewulf J, Hald T, Michel V, Niskanen T, Ricci A, Snary E, Boelaert F, Messens W and Davies R, 2019. Scientific Opinion on the *Salmonella* control in poultry flocks and its public health impact. EFSA Journal 2019;17(2):5596, 155pp.<https://doi.org/10.2903/j.efsa.2019.5596>



## OCCURRENCE AND PREVENTION OF SALMONELLA

The European Commission's programme for the protection of animal and human health includes recommendations for all stages of food production:

- farm
- production
- transport
- processing, storage and consumer sales (retail and catering)
- veterinary medicine, including vaccinations.



According to the EU directive EC No 2160/2003 on the control of *Salmonella* and other zoonoses:

- vaccination is considered a key intervention in preventing *Salmonella*;
- vaccinations against *Salmonella* reduce egg excretion and contamination, which is why they are used in all Member States where the frequency of infections of laying hen flocks is > 10% (while most EU countries currently do not exceed 2%);
- both types of vaccines (live or inactivated) can be safely used;
- live vaccines may be accepted:
  - during rearing: if a differentiation method is available,
  - during production: if the label indicates so;
- these vaccines are used against *Salmonella enteritidis* (SE) and *Salmonella typhimurium* (ST);
- it is very important that vaccination takes place in accordance with the indications of the vaccine manufacturer.



**Mandatory vaccinations against *Salmonella* are used in many countries, where they are often financed from the state budget and EU funds, on average in 50%.**

Vaccination	Country	Serovar	State surcharge
MANDATORY	Belgium	SE (if> 10%)	YES (60% of costs)
	The Czech Republic	SE (if> 10%)	NO
	Hungary	SE (if> 10%)	YES (2 doses)
	Spain	SE (if> 10%)	NO
	Italy	SE (if previous herd was infected)	NO
	Greece	SE (if> 10%)	YES
	Cyprus	SE (if> 10%)	YES
	Germany	SE flocks> 350 birds	In some regions
	Austria	ST when the positive case of S.T. was recorded in the previous production cycle	YES (55%)

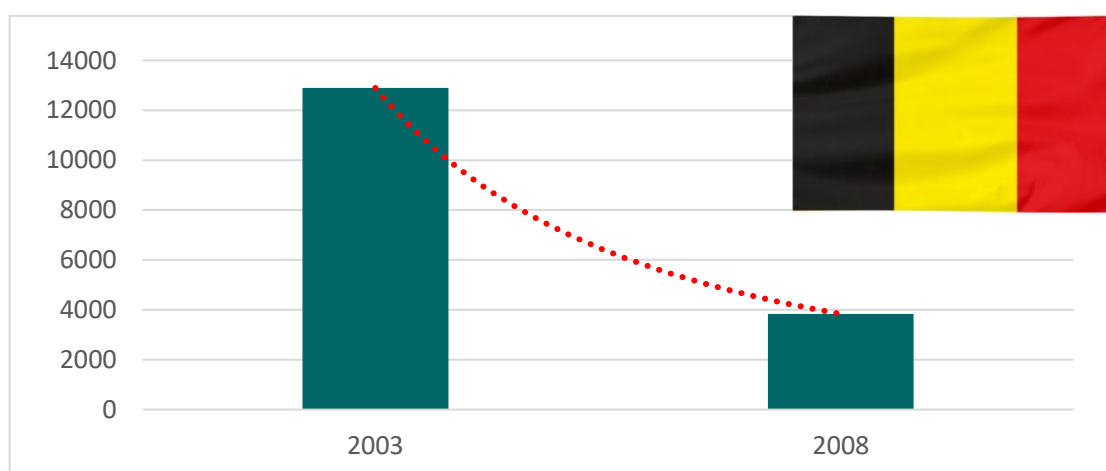
## OCCURRENCE AND PREVENTION OF SALMONELLA

Vaccination	Country	Serovar	State surcharge
MANDATORY	The Netherlands	Regardless of the number of serotypes	YES (50%)
	The United Kingdom	SE	NO
	Brazil	SE and ST - as part of the British Lion Eggs (90% of eggs produced)	NO
	Latvia*	SE (if > 10%)	Yes (100%)
RECOMMENDED	South Africa	SE (if > 10%)	NO
	France	SE (if > 10%)	NO
NOT APPLICABLE	Denmark	No sufficient number of infections registered	NO
	Finland		NO
	Sweden		NO
	Ireland		NO
NO OBLIGATION	Poland	-	NO
	Lithuania	SE	YES (100%)

\*Latvia: 1. finances the purchase of vaccines even if the SE is <10%; 2. in 2019 95% of laying flocks of laying hens were vaccinated against SE and the level of prevalence was close to 0%.

There is a clear trend indicating that in countries where there is an obligation to vaccinate laying hens, the percentage of infected herds is significantly lower than in other Member States, especially in Poland.

**Fig.** The degree of prevalence of Salmonella among laying hens of commercial laying hens in Belgium before the introduction of the eradication programme in 2003 and in 2008.



## OCCURRENCE AND PREVENTION OF SALMONELLA

### Example of Belgium

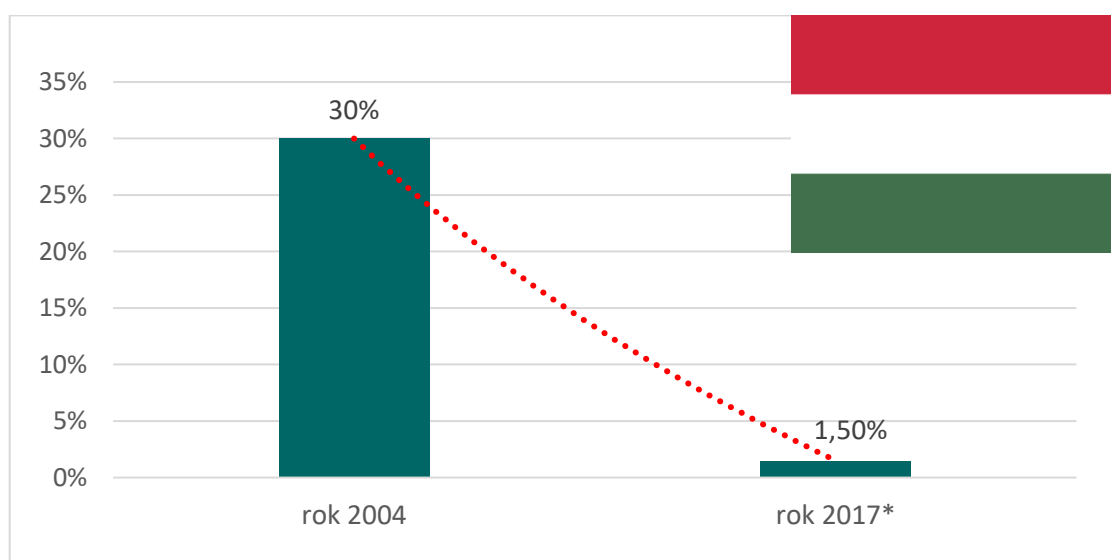
After the onset of the compulsory vaccination programme against Salmonella in 2004 in Belgium, laboratory-confirmed human cases of salmonellosis fell from 12,894 in 2003 (89% due to SE) to 3,831 in 2008.

### Example of Hungary

An excellent example is Hungary, which coped well with salmonellosis in laying hens. In the years 2004–2005, the level of *Salmonella* prevalence among laying birds was as much as 30%. This situation led to the introduction of the *Salmonella* control programme, which was mainly based on vaccination of chickens. The programme was a huge success, because in 2017 the level of *Salmonella* prevalence in Hungary among laying hen flocks was only between 1% and 2%. (Based on the EFSA report: Prevalence of target Salmonella serovars in laying hens, EU, 2008-2017).

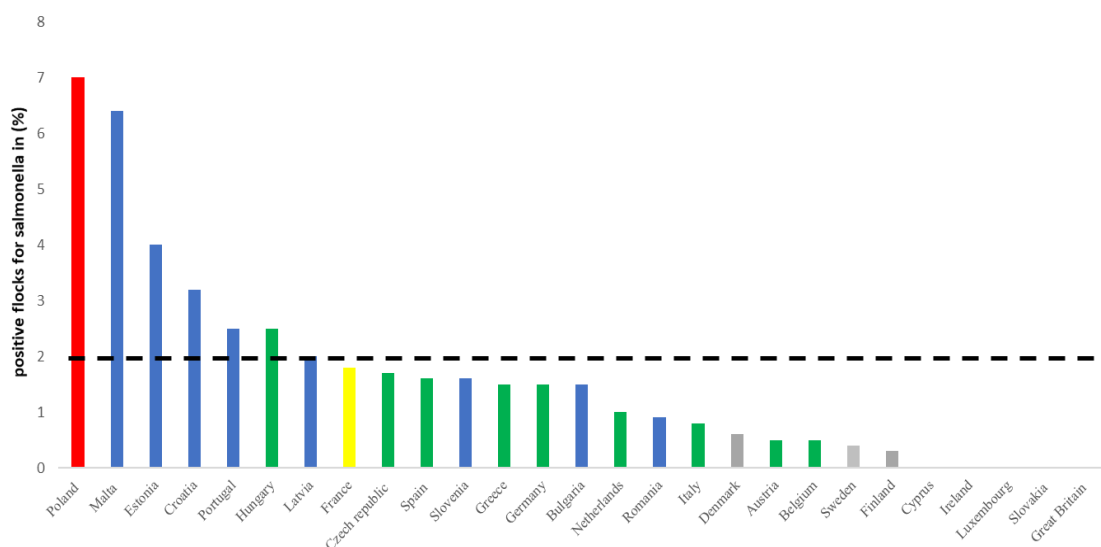
The success of the programme in Hungary is undoubtedly linked to the introduction of compulsory commercial vaccination of laying hens by the government. Currently, the vaccination obligation is maintained in Hungary if the prevalence level in the examined herd exceeds 10%.

**Fig.** The degree of prevalence of Salmonella among laying hens of commercial laying hens in Hungary before the introduction of the eradication programme in 2004 and in 2017



## OCCURRENCE AND PREVENTION OF SALMONELLA

**Fig.** Presence of commercial flocks of laying hens of *Gallus gallus* during production on *S. Enteritidis* or *S. Typhimurium* (including single-phase variants) and targets for Member States (EFSA, 2016).



Colour marking: green – mandatory vaccination, yellow – recommended, blue – no vaccination obligation / small producer, grey – no issues

### OUTCOMES OF THE IMPLEMENTATION OF THE NATIONAL PROGRAMME FOR THE CONTROL OF CERTAIN SALMONELLA SEROTYPES IN LAYING FLOCKS OF HENS (GALLUS GALLUS DOMESTICUS) IN POLAND

The principles of the national salmonellosis control programme in Poland now emphasise prevention, biosecurity and effective eradication of bacteria at source, shifting more responsibility to breeders than in previous years. "The national programme for the control of certain *Salmonella* serotypes in laying flocks of hen (*Gallus gallus*)"<sup>4</sup> has been implemented in the territory of the Republic of Poland since 2008, and in 2018 as an annual programme.

In 2018, a revised national control programme for *Salmonella* in laying hen flocks entered into force. According to it:

- producers are not subject to an order to slaughter or kill laying hens infected with *Salmonella* serotypes covered by the programme (SE and ST)
- hens from an infected herd can be slaughtered or kept until the end of the production cycle, at the decision of the owner, and the eggs for consumption can be heat treated and then placed on the market

<sup>4</sup> Regulation of the Minister of Agriculture and Rural Development of 20<sup>th</sup> December 2016 on the introduction of the "National programme for the control of certain *Salmonella* serotypes in laying flocks of the chicken species (*Gallus gallus*)" for 2017.

## OCCURRENCE AND PREVENTION OF SALMONELLA

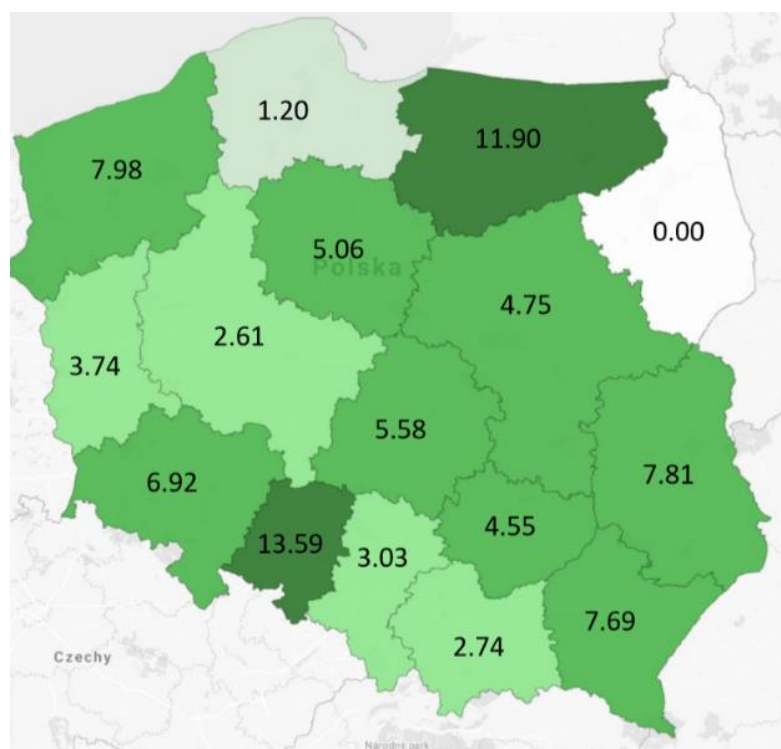
- producers will not be able to obtain compensation for the liquidation of Salmonella infected laying hens flocks as part of the implementation of national Salmonella control programmes
- producers are not required to vaccinate laying hens against SE and ST
- producers do not receive subsidies for vaccinations if they carry them out.

Regulations place more emphasis on biosecurity and effective eradication of bacteria at source, but the primary responsibility lies with the producer.

The programme in 2018 covered all herds, with the exception of direct sales and production for own use. In 2018, a total of 2,799 flocks of laying hens / 2,426 adult flocks were examined as part of the owner and / or official survey. In 2018, positive results for *Salmonella* serotypes covered by the programme were found in 122 flocks of laying hens in 15 out of 16 voivodships, including 114 results for adult flocks. *S. enteritidis* was found in 120 herds, *S. typhimurium* in 2 herds.

Prevalence in 2018 in all herds was 4.36%, while in adult herds 4.70%, thus the EU target was not achieved. Only in 2 out of 16 voivodships, prevalence in adult herds was below 2%.

**Fig.** Map showing Salmonella prevalence per voivodships in 2018.



## OCCURRENCE AND PREVENTION OF SALMONELLA

---

The current national programme (2019-2020) introduced by the Minister of Agriculture and Rural Development includes further maintenance of extended official routine tests covering all flocks on the farm (instead of at least one flock per year, on a farm with at least 1,000 birds), as there are reports of further infections in humans whose occurrence is related to eggs originating in Poland. It is worth adding that the costs of running the programme itself since 2008 are over PLN 350 million.

### CONCLUSION 3

**Poland's exceeding the EU guidelines regarding the level of Salmonella infections in laying flocks of laying hens requires immediate and comprehensive action. Otherwise, Poland may face a ban on exporting eggs to the European Union.**

## ECONOMY OF THE SALMONELLA PROBLEM

### ECONOMY OF THE SALMONELLA PROBLEM

Losses to the economy caused by salmonellosis are calculated in hundreds of millions of zlotys.

#### COSTS OF SALMONELLOSIS

##### Costs of salmonellosis on the side of the healthcare system and social costs:

The cost of treating one patient in Poland is estimated at about 2,000 PLN. In the European Union, on the other hand, the average cost is 1000 euros (FCC Consortium 2011). With the number of cases of 10,000 people a year, as is currently the case in Poland, this is a significant amount of PLN 20 million. On the other hand, non-treatment related losses, i.e. absence from work and related economic losses, are not estimated.

##### Salmonellosis costs incurred by breeders and producers:

Salmonellosis cause significant losses in agriculture in animal husbandry due to reduced quality of food products. On the other hand, they also cause very high economic losses in production, e.g. due to increased falls due to *Salmonella gallinarum* infections.

##### Other costs include:

It has been calculated that the US economy loses over USD 2.5 billion annually due to *Salmonella* infections, and in Australia around USD 44 million.

**Table.** Costs of potential losses for industry due to damaged eggs, battery depopulation and eggs not laid in 2017 in Poland caused by salmonellosis salmonellozę

Average producer price for M size eggs (PLN)	Losses due to destroyed eggs (PLN)	Net income from a flock of 15,000 laying hens in a battery system (2017) (PLN)	Potential losses due to depopulated birds in the battery system (PLN)	Average number of eggs per hen (count of eggs)	Potential losses due to unwrapped eggs (PLN)
0,18	666 685	300 000	167 761 620	300	452 956 374

## ECONOMY OF THE SALMONELLA PROBLEM

According to a comprehensive estimation model created by the US Department of Agriculture (USDA, 2018), the average loss caused by *Salmonella* infection is USD 6.0 per hen.

- Losses related to egg production: penalties resulting from breaches of contracts with retailers
- Chicken losses during Salmonella outbreak: costs of destroying birds, transport and disinfection of slaughterhouses
- Hygiene after Salmonella: number of disinfection / cleaning cycles until the henhouse is re-diagnosed negative for bacteria

### EXAMPLE

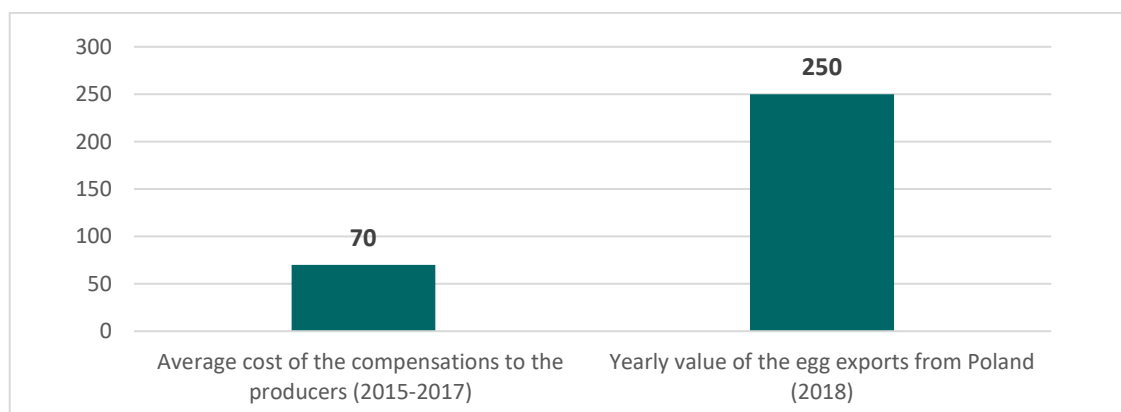
If in Poland there are 48,536,018 laying hens and the average percentage of infected herds is 4.7%, the losses incurred due to infection would amount to over PLN 52 million.

## RISK OF LIMITING OR LOSING INTERNATIONAL EGG EXPORT MARKETS FROM POLAND DUE TO THE RISK OF INFECTION WITH SALMONELLA

If Poland continues to exceed the EU requirements for the percentage of commercial flocks of laying hens infected with *SE* and *ST*, the import of Polish eggs to European countries will be significantly reduced or suspended, and Polish producers will be forced out by suppliers from other countries (including non-European ones).

The volume of egg exports from Poland is around 200,000 tonnes per year and calculating the value of one tonne of eggs as EUR 1,250, it is the amount of PLN 250 million of the value of exported eggs from the country.

**Fig.** Potential losses to the Polish state budget if the Salmonella problem is not resolved





## ECONOMY OF THE SALMONELLA PROBLEM

---

The costs of running a national programme to control certain *Salmonella* serotypes in laying hens, as well as to cover losses incurred by poultry producers due to salmonellosis since 2008 have been over PLN 350 million. Considering that the EU requirements regarding prevalence of *Salmonella* were significantly exceeded in laying flocks of laying hens in Poland, the measures taken at that time are unfortunately ineffective.

In 2016, due to the *Salmonella* bacteria found in flocks of laying hens, Polish breeders received compensation from the state budget in the amount of nearly PLN 10 million gross for breeding hens and over PLN 30 million for laying hens. Importantly, without much positive impact, because the recorded number of salmonellosis has been increasing for several years. Therefore, it seems that this money was not well spent. The cost of compensation paid to producers for hens killed or slaughtered by the order of the Veterinary Inspection authorities, or for hens killed as a result of the measures ordered by these authorities during the implementation of the above programme and for destroyed consumption eggs in 2015-2017, was approx. PLN 140 million.

After summarizing the total costs of running the national programme in the years 2008 - 2018 together with over planned compensation for losses incurred, the programme is estimated at nearly PLN 490 million.

In 2018, changes were introduced according to which egg producers cannot claim compensation for losses related to *Salmonella* infections, which significantly reduced the costs of running a national programme to combat certain *Salmonella* serotypes in laying hens' flocks.

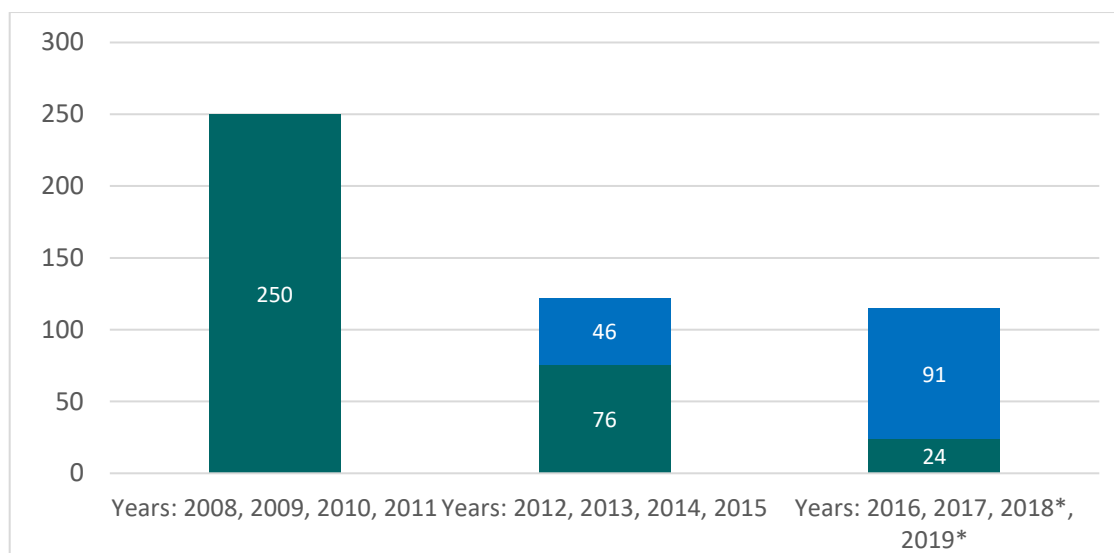
**These changes in the programme had no effect on the reduction of *Salmonella* in commercial flocks of laying hens.**

The national control programme for certain *Salmonella* serotypes in flocks of laying hens does not bring Poland closer to achieving the EU target and requires further changes.

Based on the experience of European countries that have coped with the *Salmonella* problem and radically reduced its prevalence level, the introduction of mandatory vaccinations, while maintaining restrictive biosecurity principles and the correct culture of breeding will certainly contribute to the expected results

## ECONOMY OF THE SALMONELLA PROBLEM

**Fig.** Costs in PLN millions of running the national programme for controlling certain *Salmonella* serotypes in commercial flocks of laying hens of *Gallus gallus domesticus* species in individual time intervals - blue (costs provided for in the Budget Act) - orange (costs not provided for in the Budget Act, but incurred, financed from transfers. These costs largely result from the payment of additional compensation to farmers)



\* The years 2018 and 2019 are the first years after the eradication of compensation for producers for losses caused by *Salmonella*. Źródło: opracowanie kalkulacje

## CALCULATION OF THE COST OF VACCINATION OF COMMERCIAL LAYING HENS AGAINST SALMONELLA IN POLAND

The cost of a full and optimal dose of the vaccine for *SE* and *ST*, including its 3-fold administration, is about 0.46 PLN for one hen. In the calculation below, a population of approx. 40 million chickens of laying hens hatched in 2019 (KIPDiP, 2020) in Poland has been assumed. Therefore, the cost of vaccinations for laying hens in Poland would be **PLN 18.4 million** per year.

With an additional payment of up to 50% of the vaccination value, which in Poland would amount to approx. **PLN 9.2 million** from the state budget or EU funds as it is adopted in other European countries, the *Salmonella* problem could be significantly reduced and the risk of any losses for the state budget and industry caused by *Salmonella* reduced.

It should also be remembered that the suggested actions are effective, the *Salmonella* infection control must cover all poultry production cells (e.g. breeding flocks and birds for meat use) to destroy the reservoirs of the germ. Imported birds should also be included in the programme.

## ECONOMY OF THE SALMONELLA PROBLEM

---

### CONCLUSION 4

The cost of vaccination subsidies against the occurrence of SE and ST in commercial flocks of laying hens is significantly lower than the costs of maintaining the national programme for the eradication, control and prevention of this disease, as well as than the potential losses caused by the loss of international Polish egg export markets.

## RECOMMENDATIONS

---

### RECOMMENDATIONS

In Poland, the EU target for *Salmonella* in laying hens has not been achieved and still exceeds 2%. This is a problem that requires immediate action, as the *Salmonella* control programme in force in Poland is insufficient, despite significant financial outlays.

Regulation 2160/2003 of the European Parliament and of the Council requires EU Member States to control salmonellosis and eliminate *Salmonella* in animals, in animal nutrition environments and in food of animal origin, as well as to monitor their resistance to antibacterial substances. By implementing the obligations imposed by the above-mentioned EU legal acts, Poland has started to assess the epidemiological situation in this respect as an important factor in protecting human health. In order to reduce the prevalence of salmonellosis in humans, effective systems should be put in place to ensure safety in the production, marketing and preparation of food. The production of poultry eggs is particularly urgent. Control of food of animal origin should be carried out at all stages of production, and the control system against

*Salmonella* infection should be multidirectional and take into account:

- strong biosecurity and monitoring of farms at every stage of poultry production and at every production cycle,
- production of infection-free chicks,
- the use of antibacterial drugs fully controlled by a veterinarian,
- preventive vaccinations in accordance with the state of the art and recommendations of the vaccine manufacturer,
- appropriate care for the gastrointestinal tract health (e.g. application of the beneficial bacterial flora and preparations acidifying the contents of the gastrointestinal tract)
- avoiding feed infections,
- elimination of *Salmonella* from the breeding environment (disinfection of poultry buildings and means of transport)
- implementation and compliance with quality systems such as: Good Hygienic Practice (GHP), Good Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Point (HACCP)

In addition to the above measures of the *Salmonella* infection control system, one of the systemic actions neglected in Poland, which will successfully contribute to the elimination of the dangerous *Salmonella* strains recommended by EFSA, is mandatory and co-financed by the state to vaccinate laying hens.

This method is successfully used in EU countries, where *Salmonella* in the flocks of laying hens below 2% has long been achieved. Achieving the EU goal will increase competitiveness and allow the development of the Polish egg production sector on the Community and global market.