

## BRUCELLOSIS CONTROL IN SMALL RUMINANTS IN THE REPUBLIC OF MACEDONIA

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**Abstract:** *Aim:* To present the main goals and activities of the strategy for control of brucellosis caused by *B. melitensis* in sheep and goats in the Republic of Macedonia.

*Methods:* Relevant documents and reports from the Veterinary Directorate were used to present the approaches for control of the disease in small ruminants in R. Macedonia. The new strategy for control and eradication of brucellosis started its implementation in 2008 with combination of measures for test and slaughter of the seropositive sheep and goats, mass vaccination and vaccination of young replacements.

*Results:* In 2008, a total of 596,213 animals have been tested in 5,820 flocks out of which 16,853 (2.8%) had *Brucella* positive results in 636 (10.9%) flocks. In 2009, a total of 543,011 sheep and goats had been tested in 5,507 flocks out of which 9,606 (1.8%) animals showed positive results in 666 (12.1%) flocks. While the number of positive flocks does not indicate great improvement, the individual number of *Brucella*-positive animals has decreased dramatically. The number of human cases in 2008 and 2009 were 490 and 287 respectively. Direct savings only from compensation to farmers for slaughtered animals for 2008 and 2009 are estimated to be more than 100,000,000 denars ( $\approx$  1.6 million Euro).

*Conclusion:* Results from 2009 have been evaluated and foreseen amendments will allow that the country will be systematically divided in a more detailed epidemiological fashion, i.e. division of the country into epidemiological units based on the disease status and accepted risk and implementation of appropriate measures therein.

**Key words:** Brucellosis, small ruminants, vaccination, test and slaughter.

*Background of sheep and goat production  
in the Republic of Macedonia*

Sheep production has a long tradition in R. Macedonia, and has always played an important role in livestock production. Small ruminant, especially sheep, production is influenced by factors such as the climate which is semi-arid, geography, which comprises hills and mountains and availability of grazing land. The 651,000 ha of pastures, 53,000 ha of meadows and 36,000 ha of fodder crops, represent a good basis for sheep and goat production. The pastures, being located in the hills and mountains comprise 49% of the overall agricultural land [1].

The breeding structure of the sheep population in R. Macedonia consists mainly of two varieties of the Pramenka breed, Ovcepolian (about 180,000 or 26%) and Sarplanian (about 110,000 or 16%) the remaining being Avasi and Virtemberg mainly cross-breed animals but also some pure breed animals. Commonly, private farms raise different livestock species. According to the survey conducted by Armbruster (1997) in 93 farms, 63% kept sheep, 55% cattle, 59% pigs, 51% goats and 67% equids. From these 93 farms, 77% kept different species, mostly three to four different species per farm not considering poultry which is also kept by most farms [2]. Farms are very often operated by labour of the extended family, although sheep flocks combined by different owners may pay a shepherd for summer mountain grazing. As shown in Table 1, sheep farms are mainly small with average of 10–100 animals per farm based on the official data from the Identification and Registration data base.

Table 1 – Табела 1

*Size structure of the sheep flocks in R. Macedonia in 2009*  
*Сѝрукѝура сѝоред љолемина на сѝадаѝа со овѝи во Р. Македониѝа во 2009*

Number of sheep	Number of flocks	Number of sheep in flocks
1–10	374	1842
11–50	1451	44518
51–100	1423	104983
101–500	2327	457126
> 500	116	115221
Total	5691	723690

The sheep production system in R. of Macedonia is known as semi-nomadic extensive, and is characterized by the use of natural resources. The

production technology is traditional. From the middle of May most of the big (> 1,000 animals) farms migrate to mountainous summer pastures where free-range off-farm grazing is on the extensive alpine pastures. Transport to summer grazing is by rail, road or on foot. Summer grazing lasts until the beginning of November. In the other half of the year flocks are moved to lowlands where they are housed and stall-fed on the farm. Winter grazing, depending on weather conditions, is usually on the pastures around the villages. In winter, when nutritional requirements are at their highest, ewes are fed less than their requirements in most cases.

### *Brucellosis in humans in the Republic of Macedonia*

Brucellosis is considered to be one of the main zoonotic diseases in R. Macedonia. As illustrated in Table 2, the number of reported human infections has not decreased significantly despite the eradication programme that is in place.

Table 2 – Табела 2

*Number of human brucellosis cases in the Republic of Macedonia, 1997–2008*  
*Број на заболени лица со бруцелоза во Р. Македонија, 1997–2008*

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Cases	773	531	460	422	414	405	378	297	323	309	381	490

Source: Institute of Public Health, Skopje

The real number of cases of human infection is probably much higher, due to the high proportion of undiagnosed cases. According to the World Health Organisation (WHO), an approximation of the true numbers of cases in the Mediterranean countries, can be obtained by multiplying at least by a factor of three the number of cases reported [3].

The costs of disease in humans are treatment, hospitalization and a reduction in man-days of work, both partial and permanent. Long and stressful treatment and permanent reduction in ability makes the economic losses due to brucellosis in humans difficult to assess [4].

### *Brucellosis in small ruminants in Macedonia*

Brucellosis in small ruminants caused by *B. melitensis* is continuously causing great loses in Macedonian livestock production and is considered as the

biggest animal health problem in R. Macedonia, at the same time being a priority human health hazard.

The serious consequences are the main reason why brucellosis is a top priority of the state-financed programmes each year. In the past years the Veterinary Directorate has been trying unsuccessfully to bring the disease under control, at the same time spending huge financial resources from the state budget, but as illustrated in Table 3 the results of these efforts have not been encouraging.

Table 3 – Табела 3

*Number of tested, positive and slaughtered sheep and goats and financial resources spent for controlling of brucellosis in R. Macedonia, 1999–2009*

*Број на испитани, позитивни и заклани овци и кози и појрошени финансиски средствија за контрола на бруцелозата во Р. Македонија, 1999–2009*

Year	Test and slaughter activities and costs				
	Tested animals		Slaughtered		Financial resources spent (MKD denars)**
	Total	Positive	No.	% from positive	
1999	381,142	2,116	-	-	22,868,520,00
2000	670,919	2,026	1,115	55.9%	46,157,640,00
2001	752,397	4,059	1,660	40.9%	53,783,820,00
2002	806,861	10,102	8,014	79.4%	97,165,875,00
2003	804,067	7,029	3,613	51.4%	76,379,943,00
2004	640,221	15,413	8,579	55.7%	109,715,238,00
2005	583,932	13,141	9,750	74.2%	111,797,687,00
2006	594,279	13,493	8,453	62.6%	75,184,813,00
2007	291,536	18,978	13,016	68.6%	107,361,050,00
2008	596,213	16,853	14,659	87.0%	111,647,667,00
2009	543,011*	9,606*	8,000*	83.3%	141,887,261,00
<b>Total</b>	<b>6,664,578</b>	<b>112,816</b>	<b>76,859</b>	<b>68.13%</b>	<b>953,949,514,00</b>

Source: Veterinary Directorate, Ministry of Agriculture, Forestry and Water Economy of R. Macedonia

\*Results apply until September 2009 (after which retesting of previously positive flocks continued)

\*\*Funds for compensation, testing, taking blood samples from sheep, disinfections of farms and animals

The inconsistency in implementation (different coverage of tested and culled animals), but also the lack of a census of existing flocks and individual identification of animals, semi-nomadic movement of animals, poor or no movement control, insufficient financial resources, unpreparedness of the Veterinary Directorate to directly and effectively combat the disease and, last but not least, an impractical strategy were factors for further spread of the disease on the whole territory of R. Macedonia.

In 2008, after an evaluation of the situation, the Veterinary Directorate introduced new programme for control of brucellosis in small ruminants. The selection of the strategy was based on the epidemiological situation in the country, the resources available both financial and human, recommendations in the literature and experiences of different countries in combating the disease. The existing data in 2008 showed that the most eastern region is traditionally free of the disease (the disease was never confirmed or only isolated outbreaks reported). At the same time there is a region consisting of several municipalities where the disease prevalence both on flock and individual animal level is very high. The largest part of the territory of R. Macedonia situation had moderate flock prevalence with regard to brucellosis.

The adopted strategy based on this data was a combination of test and slaughter in some municipalities of the eastern part of R. Macedonia with low prevalence or brucellosis-free regions where vaccination was forbidden. In highly affected municipalities a mass vaccination was prescribed in the first year of the strategy implementation with vaccination of young replacement in the following years. In the remaining largest part of the territory of R. Macedonia vaccination of replacement animals and test and slaughter of adult animals was prescribed. The vaccine, Rev 1, was applied conjunctively in animals 3–6 months of age. The diagnostic test used was Rose Bengal Plate Test (RBPT) as a screening test. All positive RBPT were confirmed with ELISA. The reason for not using Complement Fixation Test (CFT) as a confirmatory test was because it was expected that a large number of positive animals would be revealed, which would be beyond the capacity of the approved laboratory. The anticipated problem with anticomplementarity, which was confirmed, was another reason for not using CFT as a confirmatory test.

The expected results from the new strategy were:

1. In the medium term to stop the further spread of the disease, i.e. decreasing of flock incidence.
2. In the short term to decrease the absolute number of sero-positive individual animals.
3. In a short term to decrease the number of affected humans.

4. Generally decrease in financial resources required for controlling of the disease.

One year after start of implementation of the new strategy following results were achieved:

1. Stop of further spread of disease, i.e. decreasing flock incidence

In 2008 a total of 5,820 flocks were tested of which 636 or 10.9% had at least one positive animal. In 2009 out of 5,507 flocks tested 666 or 12.1% have at least one positive animal. In both years the number of flocks with only one positive animals was very high. Given that most of the flocks gave negative results in following retests, these flocks will be excluded from the analysis and regarded as singleton positives. Therefore, out of 5,820 tested flocks in 2008, 506 had more than one positive animal or 8.7%. In 2009 out of 5,507 tested flocks 478 or 8.7% had more than one positive animal. Two hundred and six positive flocks in 2009 were also positive in 2008 (39.2%). Out of 526 flocks positive in 2008, 122 gave negative result in 2009. The number of new infected flocks in 2009 was 140, making an annual incidence rate of 2.41%. The remaining flocks found positive in 2009 and not positive in 2008 did not exist or were not tested flocks in 2008.

A limited success in decreasing the number of positive flocks is expected in the short term. Even young replacement animals have been immunized, still a lot of naive animals (more than 75%) exist in a flock, which leaves an "open door" for the entry of new infection into the flock.

2. Decreasing of the absolute number of sero-positive individual animals

In 2008 a total of 596,213 sheep and goats were tested, of which 16,853 (2.7%) gave a sero-positive result. In 2009 out of 543,011 tested animals 9,606 or 1.8% were found sero-positive. The average within flock prevalence in 2008 was 17.5% and in 2009 was 14.1% while the median prevalence was 11.6% and 8.3% respectively. The average absolute number of positive animals within a flock in 2008 was 26 and in 2009 was 19. The median of positive animals was 12 and 9 in 2008 and 2009 respectively.

It is apparent that some improvement with the disease within flocks had been achieved. Although for disease control in the country what is most important is the number and distribution of positive flocks, decreasing the absolute number of positive animals within flock is also very important since it decreases the financial resources required for control of the disease. In the subsequent years it is expected that the situation will be even more improved by an increase in the number of immune and a decrease in the number of susceptible animals.

### 3. Decreasing the number of affected humans

Based on data from the Institute of Public Health and Ministry of Health of R. Macedonia, the number of recorded positive humans in 2009 was 287. Compared with 2008 (490) it decreased by more than 40%. Some regions experienced a more remarkable decrease in the number of positive humans than others. In general, most of the regions had fewer positive humans compared with previous years. The situation with the brucellosis in humans in the R. Macedonia today is still at high level, similar to what it was in the 1980s.

The decreased number of new infections as well as proper and strict implementation of prescribed measures resulted in lesser contamination of the environment and therefore a decrease in human cases.

### 4. Decreasing financial resources required for controlling the disease

Financial resources have been mentioned as one of the main obstacles to a proper implementation of the test and slaughter strategy for the control of brucellosis in small ruminants in the R. Macedonia. Nevertheless, a great amount of money was spent in the previous years for controlling the disease without any success. More than half of the financial resources spent annually (in the last four years more than one million Euro per year) were for compensation to farmers for slaughtered positive animals. In two years of implementation of the new strategy, taking into account the prescriptions of the legislation, savings from compensation for slaughtered animals alone are estimated to be more than 1.6 million Euros.

Savings are made based on the following directions:

1. In 2008, animals from Stip, Radovis and Valandovo were not tested. Still, significant reductions in the number of positive humans in these regions have been observed. It is estimated that at least 8,000–10,000 positive animals (including retesting) would have been found in these regions if testing had been performed in 2008.

2. A decreasing of approximately 6,000 positive animals was observed in 2009 compared to 2008. If animals had been tested in the “vaccinated” region, at least another 5,000–6,000 positive animals would have been expected.

3. All together, there was a saving of some 20,000 or more animals that were not slaughtered and afterwards compensated for, per average price of 5,000 denars (about 82 Eur) per animal, making a total of approximately 100,000,000 denars or 1.6 million Euros savings only in compensation of farmers. In addition, the significant number of positive animals that should have been slaughtered if the test and slaughter policy had been adopted would have compromised the speed and quality of the implemented measures, as well as requiring great human resources.

In 2009 a thorough evaluation of the success of the strategy was made. It was concluded that the strategy had a sustainable success. However, by the proper implementation of the measures in 2008 and 2009, especially in the coverage of the flocks, it was shown that in some regions (Skopje, Tetovo and Gostivar) flock-level disease prevalence is very high. Also, most of the “big” flocks have positive animals. Therefore, the new strategy will be directed towards a division of the territory of the country in a more detailed epidemiology fashion, i.e. on epidemiological units. Based on the disease status, implementation of mass vaccination or vaccination of replacement animals and test and slaughter of adult animals will be prescribed.

### *Conclusion*

Brucellosis in small ruminants caused by *B. melitensis* continuously is causing great losses in Macedonian livestock production and is considered as the biggest animal health problem in R. Macedonia, at the same time being the greatest human health hazard.

The Macedonian Veterinary Directorate was for many years in the past trying to control the disease by applying a test and slaughter strategy. However, results from these efforts showed that implementation of only the test and slaughter strategy in a given situation in the country cannot bring the disease under control. Both flock and individual prevalence were increased, showing that the disease was still spreading. Based on these results, the Macedonian Veterinary Directorate decided to change the strategy to a combination of vaccination and test and slaughter. The situation with the disease and general movement patterns were the main factors in dividing the country into three larger regions where different measures have been applied: 1) mass vaccination in the first year of the new strategy implementation and vaccination of young replacements in following; 2) vaccination of replacements and test and slaughter of sero-positive adults; and 3) only test and slaughter of all animals. The first aim of the strategy was to stop the spread of the disease, i.e. to decrease the flock incidence and prevalence, to decrease the individual animal prevalence, to decrease the human incidence and to decrease the costs of the control strategy.

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## Резиме

**КОНТРОЛА НА БРУЦЕЛОЗАТА КАЈ СИТНИОТ ДОБИТОК  
ВО РЕПУБЛИКА МАКЕДОНИЈА**

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*Цел:* Да се претстават главните карактеристики и активности на стратегијата за контрола на бруцелозата предизвикана од *B. melitensis* кај овците и козите во Р. Македонија.

*Методи:* Користени се релевантни документи и извештаи од Ветеринарната управа за да се презентира пристапот за контрола на болеста кај ситниот добиток во Р. Македонија. Новата стратегија за контрола и ерадикација на бруцелозата започна со имплементација во 2008 година со комбинација на мерки за тестирање и колење на серо-позитивните овци и кози, масовна вакцинација и вакцинација на младиот добиток за одгледување.

*Резултати:* Во 2008 година беа тестирани 596.213 животни во 5.820 стада, од кои 16.853 (2.8%) беа со позитивни резултати за *Brucella* во 636 (10.9%) стада. Во 2009 година, беа тестирани 543.011 овци и кози во 5.507 стада, од кои 9.606 (1.8%) од животните покажаа позитивни резултати во 666 (12.1%) стада. Додека бројот на позитивни стада не покажа големо подобрување, индивидуалниот број на *Brucella* позитивни животни се намали драматично. Бројот на случаи на бруцелоза кај луѓето во 2008 и 2009 беше 490 и 287, соодветно. Директните заштеди само од компензацијата исплаќана на фармерите за закланите животни за 2008 и 2009 година беа проценети на повеќе од 100.000.000 денари (приближно 1.6 милиони евра).

*Заклучок:* Резултатите од 2009 година беа евалуирани и предвидените измени ќе дозволат земјата систематски да биде поделена според поде-

тален епидемиолошки план, односно поделба на земјата на епидемиолошки единици базирани врз статусот на болеста и прифатениот ризик, а потоа и соодветни мерки би можеле да бидат имплементирани.

**Клучни зборови:** бруцелоза, ситен добиток, вакцинација, тестирање и колење.

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