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# CAPACITY OF ACCREDITED TESTING LABORATORIES FOR FOOD IN BOSNIA AND HERZEGOVINA IN 2017 IN RELATION TO THE FIELDS OF ACCREDITATION

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**Abstract:** Accreditation refers to the formal recognition that a conformity assessment body (laboratory) is competent to conduct conformity assessment activities according to internationally accepted rules. The accreditation of conformity assessment bodies in Bosnia and Herzegovina (B&H) is implemented by the Institute for Accreditation of B&H (BATA). Accreditation provides confidence in the laboratory test results and it is carried out according to the standard BAS EN ISO / IEC 17025: 2006. Test laboratories for food in a wider sense include laboratories dealing with food, animal feed, drinking and swabs. The aim of the test is to determine the capacities of accredited test laboratories for food in B&H in relation to the field of examination or the field of accreditation. This enables a clear insight into the readiness of test food labs to respond to food control requirements in order to protect the health of animals and humans. During 2017, 29 food laboratories were accredited in Bosnia and Herzegovina, 8 in Republika Srpska, and 21 in the Federation of B&H. Out of 13 accredited testing areas in B&H, laboratories in Republika Srpska accredited 10 fields (76.90%), while laboratories in the Federation of B&H accredited 13 areas (100%). When it comes to different food testing fields, B&H has capacities in the form of accredited laboratories to respond to these requirements, and especially important capacities are those for physicochemical food and water testing and microbiological food testing (over 55% of accredited laboratories). They are followed by microbiological testings of animal feed and water and toxicological testing of residues and contaminants in food (over 30% of accredited laboratories)

**Keywords:** accreditation, testing laboratories, food.

# INTRODUCTION

Accreditation implies a formal acknowledgment that some conformity assessment body is competent to carry out conformity assessment activities in accordance with internationally accepted rules (34). Conformity assessment is any activity through which it is directly or indirectly determined whether the relevant requirements have been met. Conformity assessment body is a supplier-independent laboratory, certification body, inspection body or any other body involved in conformity assessment which can be a state authority or a legal or natural person.

Accreditation is a document that demonstrates competence to perform certain tasks in the area of assessment of conformity. The accreditation procedure determines the competence of legal and natural persons, which can represent, in whole or in part, a conformity assessment body in relation to the requirements of B&H, European and international standards or documents of European and international accreditation organizations.

Accreditation of the conformity assessment body in Bosnia and Herzegovina (B&H) is carried out by the Institute for Accreditation of B&H (BATA) (35). BATA is responsible for developing, implementing and maintaining B&H Accreditation System (SAB&H), implementing the accreditation and supervision procedure of the conformity assessment body, representing B&H in European and international organizations for accreditation, organizing and implementing specialist staff training in the field of accreditation, and developing and establishing information system on assigned accreditions and on documents in the field of accreditation.

BATA sets out the criteria for approving and maintaining accreditation to be met by the Compliance Assessment Bodies (TOU), the process of accreditation and the financing of the accreditation system (56) Laboratory accreditation ensures confidence in the results of laboratory tests, and is carried out according to the standard BAS EN ISO / IEC 17025: (1). Within SAB&H test laboratories, calibration laboratories, medical laboratories, inspection bodies, product certification bodies, staff certification bodies and certification bodies for the management system can be accredited.

Test laboratories for food in a wider sense include laboratories dealing with food, animal feed and drinking water testing. Also, these laboratories carry out tests in order to evaluate the microbiological purity of equipment, devices, accessories, working surfaces, work clothes and workers' hands in production facilities and means of transport that come into contact with food where there is a risk of occurrence and spread of infectious diseases (42).

The food test laboratories must be accredited in accordance with the standard EN ISO / IEC 17025 (36-38,

42). Food testing in B&H is performed by authorized state and privately-owned laboratories in both Entities, Republika Srpska (RS) and the Federation of Bosnia and Herzegovina (FB&H), in accordance with the Food Act (36, 37) and other regulastions. There is no accredited laboratory in the Brcko District (BD).

## OBJECTIVES AND TASKS OF TESTING

The aim of the study is to determine the capacities of the accredited test laboratories for food in B&H in relation to the field of testing or the field of accreditation. In this way, a clear insight into the capacity of test food laboratories to respond to food safety requirements in order to protect animal and human health will be obtained.

## MATERIAL AND METHODS

### Material

As a test material, Annex to Accreditation Certificate of Accredited Testing Laboratories in B&H was used, downloaded from the BATA website (57).

Laboratories from RS territory:

**I State Ownership**

1. PI Veterinary Institute of Republic of Srpska "Dr. Vaso Butozan", Banja Luka (5)
2. Public Health Institution "Institute of Public Health", Banja Luka (6)

**II Private ownership**

1. Veterinary Institute "Teolab", Bijeljina (7)
2. Slaven d.o.o. Veterinary Institute, Banja Luka (8)
3. Gross d.o.o. Gradiska (9)
4. Institute for waters d.o.o., Bijeljina (10)
5. "EURO-INSPEKT" d.o.o., Osijek (11)
6. SISTEM QUALITA, S d.o.o., Pale (12)

Laboratories from FB&H territory:

**I State Ownership**

1. PI "Veterinary Institute" Bihać, Bihać (13)
2. Veterinary Faculty of the University of Sarajevo, Sarajevo (14)
3. PI "Veterinary Institute of Tuzla Canton", Tuzla (15)
4. Examination laboratory PI "RAD" d.d., Tešanj (16)
5. Public Health Institute of the Federation of Bosnia and Herzegovina (17)
6. KJP Veterinary station d.o.o., Sarajevo (18)
7. ZU Public Health Institute USK, Bihać (19)
8. Federal Bureau of Agriculture, Sarajevo (20)
9. Public Health Institute SBK / KSB, Travnik (21)

10. Public Health Institute of Tuzla Canton, Tuzla (22)
11. Public Health Institute of Sarajevo Canton, Sarajevo (23)
12. Federal Agromediterranean Institute, Mostar (24)
13. PI Institute for Health and Food Safety, Zenica (25)
14. PI Veterinary Institute of HNK / Ž, Mostar (26)

**II Private ownership**

1. Zagrebinspekt d.o.o., Mostar (27)
2. The Sava River Basin Agency, Sarajevo (28)
3. PI Institute for Biomedical Diagnosis and Research "GENOM", Travnik (29)
4. DVOKUT pro d.o.o., Sarajevo (30)
5. CONTROL-H d.o.o., Mostar (31)
6. Pharmamed d.o.o., Travnik (32)
7. HERKON d.o.o., Mostar (33)

The laboratories are displayed according to the registered name and headquarters of the legal entity, without mentioning their regional locations and accredited organizational units.

**Methods**

In our research and in the statistical analysis of the obtained results we used descriptive statistical parameters as basic statistical methods. These parameters enable the description of the obtained results and their interpretation. The results of the research are presented in a tabular and graphical form. Statistical analysis of the results was done in Microsoft Office Excel statistical software.

## RESULTS AND DISCUSSION

In B&H, 29 testing laboratories for food (ALF) are accredited, of which 8 in the RS (27.60%) and 21 in the FB&H (72.40%), while in the Brčko District (BD) there is no ALF (Table 1). The ratio of ALFs among entities (RS to FB&H) is 1: 2.60. This ratio is 0.8 higher than the ratio of the population between the entities (RS: FB&H = 1: 1.8) (58).

**Table 1.** Accredited testing laboratories for food in B&H

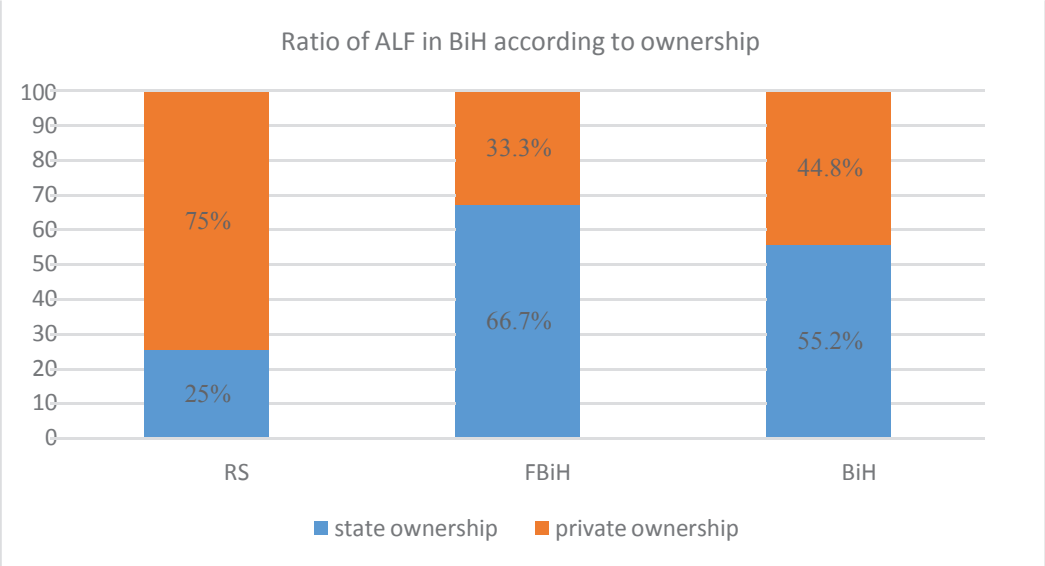
| Location | Number of ALF | % |
|---|---|---|
| RS | 8 | 27,60 |
| FB&H | 21 | 72,40 |
| BD | 0 | 0 |
| B&H | 29 | 100 |

**Table 2** and Graph 1 show the numerical and percentage ratio of ALFs in B&H according to ownership.

**Table 2**. numerical ratio of ALFs in B&H according to ownership

| Location | Number | |
|---|---|---|
| | SO | PO |
| RS | 2 | 6 |
| FB&H | 14 | 7 |
| B&H | 16 | 13 |

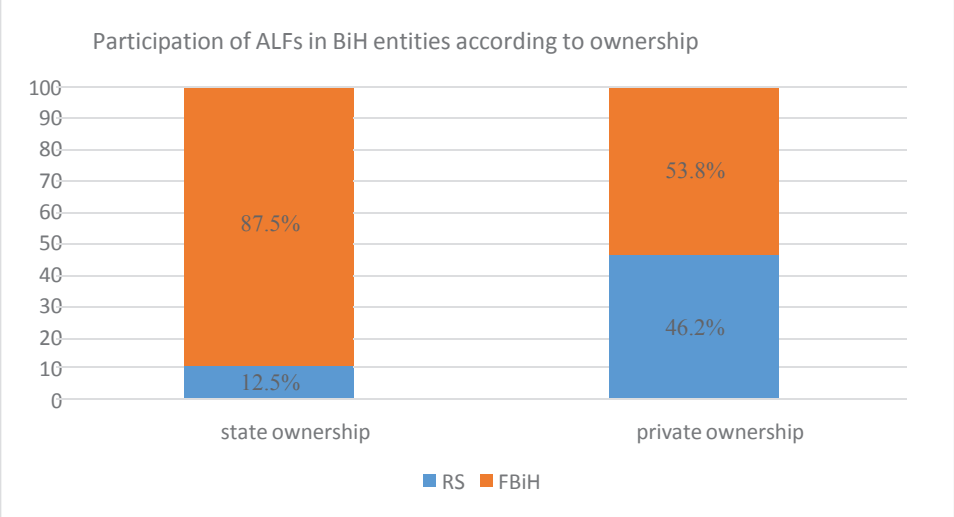
*SO - state-owned laboratories ; PO- privately-owned laboratories




**Graph 1. Ratio of ALFs in B&H according to ownership**

In RS, 25% of ALFs are in SO, 75% in PO (1: 3). This relationship is significantly different in FB&H, where 66.70% of ALFs are in SO, vs 33.30% in PO (2: 1). At the B&H level, the ALF ratio, when it comes to state and private ownership, is even (1.20: 1). Based on these data it can be concluded that in FB&H, laboratory tests on food safety controls, which are of public interest to human health, are mostly performed by state-owned ALFs. By contrast, RS, apart from its own (state), very important laboratory capacities, relies mostly on privately-owned laboratories.

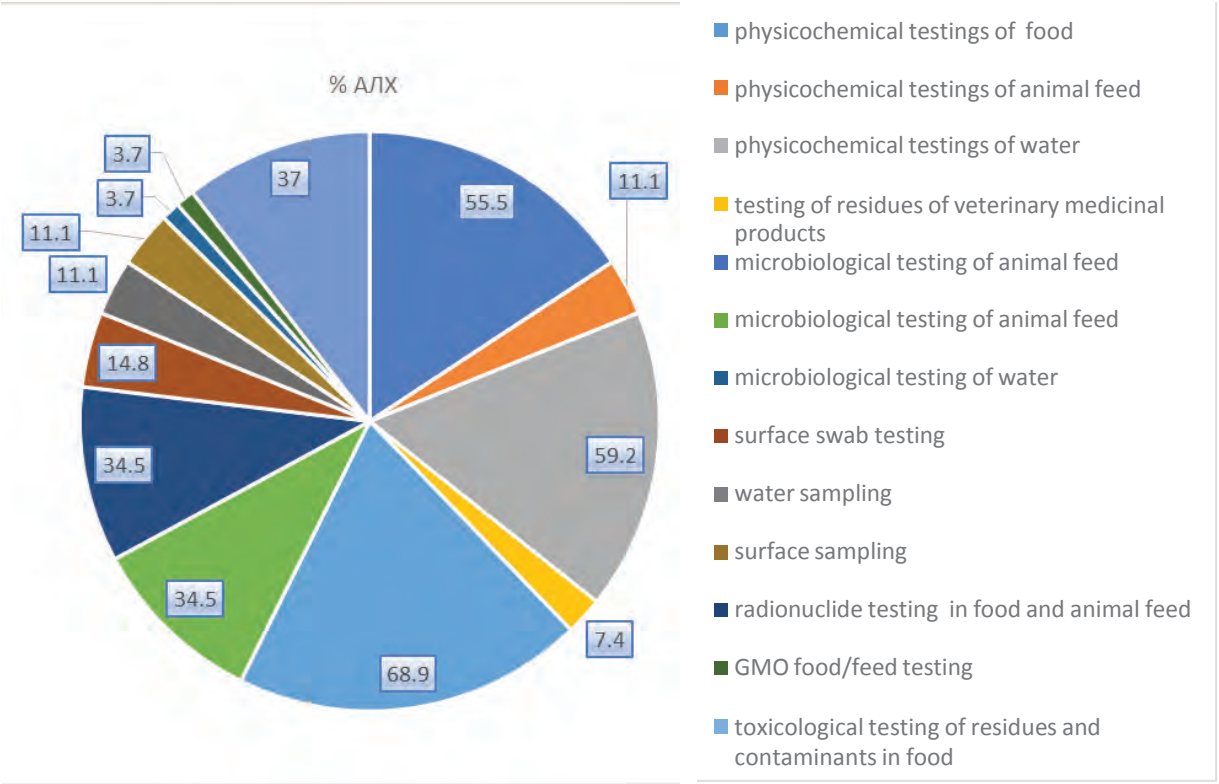
Graph 2 shows the participation of ALFs in B&H by entities in relation to ownership.




**Graph 2. Participation of ALF in B&H entities according to ownership**

Of the total number of state-owned ALF in B&H, 12.50% of them are in RS, and 87.50% (1: 7) in FB&H. This can be explained by the different organizational structure of the FB&H, which consists of 10 cantons, and therefore there are ALFs on the federal and cantonal levels. However, this ratio is too high, compared to the ratio between the number of people in the entities. But, considering that one state-owned ALF in RS accredited methods at two locations (5), and the other ALF in four of the five operating locations (6), that would be six ALFs in RS. This significantly changes the ratio of state-owned ALFs (RS: FB&H = 1: 2.30), which is approximately actual relation, considering the total number of ALFs in B&H (1: 2.60). When it comes to privately-owned ALFs in B&H, this ratio is approximately equal (1: 1,20), which is significantly different from the ratio of the total number of ALFs in B&H (1: 2,60), and the ratio of the population between entities (58). This suggests that the relation of state-owned ALFs is proportional, planned and formed on the basis of the real parameters, needs and expert assessments, while the ratio of privately-owned ALFs is random, formed on a free assessment of market conditions and financial capabilities.

Graph 3 shows representation of ALF in B&H in relation to the fields of accreditation.

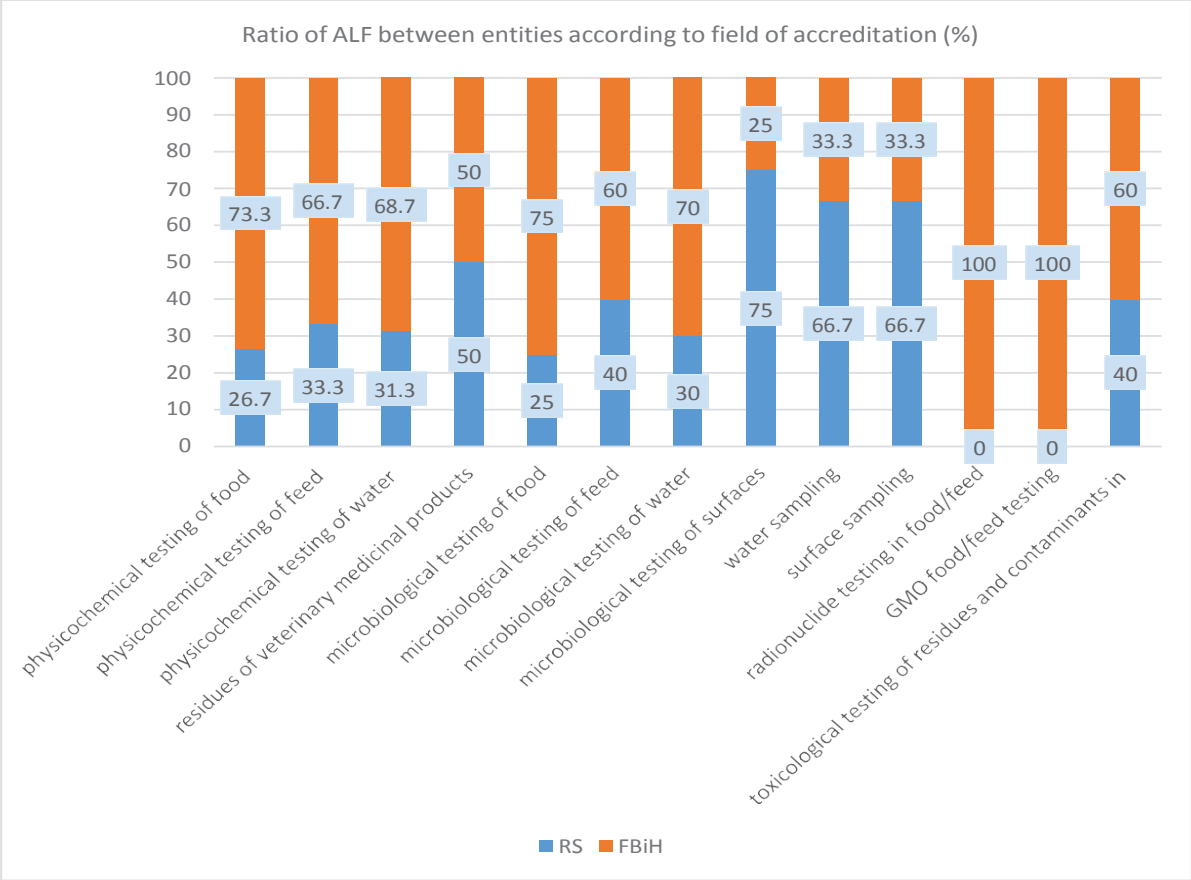



**Graph 3. Representation of ALFs in B&H in relation to the fields of accreditation**

In accordance with the Food Act (36-37), food testing laboratories must be accredited in accordance with the standard BAS EN ISO / IEC 17025. However, regulations have different requirements regarding accreditation, in some of them accredition is explicitly requested (4), while in some it is not (47, 48, 50) Regarding the microbiological examination of water, the legislation in RS doesn't include request for accredited laboratories (39), while at the B&H level it does (38). The Rulebook on the microbiological criteria for animal feed doesn't set accreditation of laboratories as a condition. For microbiological purity criteria in RS, the laboratories must be accredited to carry out these tests. ALFs in B&H accredited test methods in 13 technical fields of testing. When it comes to different food testing fields, B&H has capacities in the form of accredited laboratories to respond to these requirements, and particularly important are the capacities for physicochemical food testing (55,50%) water testing (59,20%), as well as microbiological food testing (68,90%). Microbiological tests are very demanding in terms of ambient conditions and quality assurance of laboratory testing (2, 3), primarily from the financial and technical aspect. However they are less demanding in terms of equipment (financially accessible, identical incubation temperatures, simple use, etc.) than chemical testings. Also, when it comes to mandatory microbiological tests, there is a smaller

number of parameters per sample type to which the studies are performed (4, 47, 48, 50), and this may explain a high percentage of ALFs for these tests. Unlike microbiological, physicochemical studies are more complex, by the number of parameters to be tested and by the complexity of the test procedures. A large number of sample types that are grouped on the basis of their similarity (meat, milk, honey, etc.) aslo contrubutes to this complexity (40, 41, 45, 46, 52-55). However, this obviously has not been an obstacle for laboratories to accredit test methods in the field of physicochemical testing and they take the largest percentage of accreditation field in B&H. A possible explanation for this is a large number of ALFs, a large number of parameters for testing and a large number of sample types of , so the laboratories, on the basis of their own assessment, needs and affinities, selected the test methods to be accredited. Toxicological tests of residues and contaminants in food and microbiological testing of animal feed and water are somewhat less represented. They are followed by physicochemical testings of animal feed and testing of residues of veterinary medicinal products. The fact that there is no explicit requirement of the legislation for these tests to be performed by accredited laboratories (39, 43, 44, 46, 51) might be the reason for this, along with the complexity of the test methods, the large financial expenditures for their maintenance, as well as the large number of parameters that are being tested (43, 44, 51) in toxicological testing of residues and contaminants in food and testing of residues of veterinary medicinal products.

Graph 4 shows the percentage of ALFs in the entities according to the field of accreditation




**Graph 4. Ratio of ALF between entities according to field of accreditation**

In Republika Srpska no laboratory has accredited GMO testing and radionuclide testing in food and animal feed, although there are laboratories that routinely perform these tests. This data is worrying because the RS, unlike the FB&H, does not guarantee the validity of the results obtained by these tests. The ratio of laboratories that perform physicochemical and microbiological testing of water and physicochemical testing of animal feed in the RS to laboratories in the FB&H is 1: 2, for microbiological tests of food the ratio is 1: 3 , while for microbiological testing of animal feed and toxicological testing of residues and contamination in food the ratio is 1: 1.5. The ratio is reversed in water and surface sampling and it is 2:1, while in microbiological surface swab testing the ratio is 3: 1. In testing of residues of veterinary medicinal products the ratio is equal. The testing of residues and contaminants in food is performed exclusively by state-owned ALFs , one from the RS and one from the FB&H (5, 14), total of 6.90% ALFs at the level of B&H. These laboratories are primarily veterinary in which food testing is also performed. Also, veterinary laboratories carry out physicochemical tests of animal feed (altogether 10,30% ALF) (5, 13, 14), and when it comes to microbiological testing

of animal feed, these laboratories are dominant with participation of 80% in relation to the number of ALFs which accredited this field of accreditation. By analyzing the scope of ALF accreditation (5-33), we have established that no laboratory in B&H has accredited all test methods for testing all physico-chemical parameters in food, animal feed and water, toxicological testing of residues and contaminants in food, and residues of veterinary medicinal products, which are prescribed by the legislation (38-41, 43-46, 51-55). When it comes to microbiological testing of food at the level of B&H, 6.90% of ALFs (one from the RS (5) and one from the FB&H (13), both state-owned) fully accredited the test methods in accordance with the requirements of the legal regulations (4, 47, 48, 50). Fully compliant with the requirements of the legal regulations (49), microbiological testing of animal feed has been accredited by 20.70% of ALFs, one state-owned laboratory (5) and one privately-owned laboratory (8) in the RS and four state-owned laboratories (13-15, 26) in the FB&H. Microbiological examination of water has been accredited by 10.30% of ALFs, fully compliant with the requirements of the legal regulations (38, 39), one state-owned (5) laboratory and one privately-owned (8) in the RS, two state-owned in the FB&H (15, 23). Testings in accordance with the Rule book on microbiological purity criteria (42), have been accredited in 12.50% of ALFs in the RS (one state-owned laboratory ) (5).

Table 3 shows the percentage ratio of state-owned and privately-owned ALFs in B&H according to the field of accreditation.

**Table 3.Ratio of state-owned and privately-owned ALFs in B&H according to the field of accreditation.**

| Field of accreditation | % | | | | | |
|---|---|---|---|---|---|---|
| | RS | | FB&H | | B&H | |
| | SO | PO | SO | PO | SO | PO |
| LI 2.1 Physicochemical testing of food | 50 | 50 | 72,70 | 27,30 | 66,70 | 33,30 |
| LI 2.2 Physicochemical testing of feed | 100 | 0 | 100 | 0 | 100 | 0 |
| LI 2.3 Physicochemical testing of water | 20 | 80 | 54,50 | 45,50 | 43,80 | 56,20 |
| LI 2.5 Residues of veterinary medicinal products | 100 | 0 | 100 | 0 | 100 | 0 |
| LI 3.1 Microbiological testing of food | 40 | 60 | 86,70 | 13,30 | 75 | 25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| LI 3.2 Microbiological testing of animal feed | 25 | 75 | 83,30 | 16,70 | 60 | 40 |
| LI 3.3 Microbiological testing of water | 66,70 | 33,30 | 85,70 | 14,30 | 80 | 20 |
| LI 3.7 Microbiological testing of surfaces | 33,30 | 66,70 | 100 | 0 | 50 | 50 |
| LI 17.1 Water sampling | 50 | 50 | 100 | 0 | 66,70 | 33,30 |
| LI 17.10 Surface sampling | 0 | 100 | 100 | 0 | 33,30 | 66,70 |
| LI 18.1 Radionuclide testing in food and animal feed | 0 | 0 | 100 | 0 | 100 | 0 |
| LI 19.1 GMO food/feed testing | 0 | 0 | 100 | 0 | 100 | 0 |
| LI 21.1 Toxicological testing of residues and contaminants in food | 50 | 50 | 100 | 0 | 80 | 20 |

Out of 13 accredited testing fields in B&H, laboratories in the RS accredited 11 (84.60%), and in the FB&H 13 fields (100%). At the B&H level, state-owned laboratories accredited all 13 fields (100%), while privately-owned laboratories accredited 9 fields (69.20%). Of the total number of accredited fields in RS, state-owned laboratories dominate in 27% of the fields, in 27% of the fields the ratio of state and privately-owned laboratories is the same, while in 46% of the fields the predominant laboratories are privately-owned ones. Unlike RS, in the FB&H, privately-owned laboratories are dominant in all fields (100% of state-owned laboratories in eight fields, over 70% in four fields and about 55% in one field). At the level of B&H state-owned laboratories are dominant in 76.90% of the fields, in 7.70% of them the ratio is equal, and in 15.40% of the fields are dominated by privately-owned laboratories. When it comes to physicochemical food testing, in the RS the ratio of state-owned laboratories to privately-owned ones is 1: 1, while in the FB&H and at the level of B&H this ratio is 2: 1 in favor of laboratories in state ownership. Physico-chemical testing of animal feed, testing of residues of veterinary medicinal products, GMO testings and radionuclide testing in food and animal feed in B&H are performed exclusively in state-owned laboratories (5, 13, 14). In the RS, the ratio of state-owned laboratories to privately-owned ones is significantly in favor of privately-owned ones, in physicochemical testing of water (1: 3), in microbiological testing of food (1: 1.5) , animal feed (1: 3) and in surface swab tests (1: 2). This undoubtedly indicates that, in terms of testing food from a safety perspective, Republika Srpska relies heavily on laboratories in private ownership. In the FB&H, for these fields of testing, the situation is significantly different, where

the ratio of state-owned laboratories to privately-owned laboratories is in favor of state-owned ones (in physical and chemical testing of water 1,2: 1, in microbiological testing of food 6,5: 1, of animal feed 5: 1 and in surface swab test 1: 0). At the level of B&H, the ratio of SO laboratories to PO laboratories for physicochemical testings of water is 1: 1.3, for microbiological testing of food 3: 1, microbiological tests of water 4: 1, and for microbiological testing of surface it is 1: 1. Microbiological testing of water is performed mostly in SO laboratories. In RS the ratio of SO laboratories to PO laboratories is 2:1, while in the FB&H the ratio is 6:1 and at B&H level it is 4:1. This is understandable, since drinking water is mainly intended for public supply, and state-owned ALFs are best equipped for these tests and they also have the greatest public trust. Water tests are very demanding and costly, especially the physicochemical ones, with very little space for making profit, so privately-owned laboratories do not have a significant financial interest in these tests. Water sampling in the RS is equally performed by SO and PO laboratories, while in the FB&H sampling is exclusively done in state-owned laboratories and this ratio at the level of B&H is 2: 1 in favor of SO laboratories. In surface sampling this ratio is identical at FB&H level, at the B&H level (2: 1 in favor of PO laboratories), while in the RS surface sampling is performed exclusively by privately- owned laboratories. The accreditation of the sampling methods, especially the surface sampling seems to be a marketing move rather than it is professionally justified considering the importance of accreditation of test methods in order to obtain valid results, and they actually do not have to be accredited (not a requirement of legal regulation). By analyzing accredited fields of accreditation it is noted that laboratories in state ownership accredited methods in most fields of accreditation, while privately-owned laboratories have selected demanding fields from the standpoint of accreditation, which bring higher profit because the requirements for these analyzes are more frequent (regulation, specificity of production, etc.), while the methodology and equipment is simpler. This is understandable, considering the fact that the basic reason for the existence of privately-owned laboratories is gaining profit and, accordingly, a free and targeted selection of fields for which they require work authorizations and field accreditation of the competent authorities.

## CONCLUSION

Based on the obtained results, the following conclusions are drawn:

1. In Bosnia and Herzegovina, 29 testing laboratories for food were accredited, of which 8 in the RS (27.60%), and in the FB&H 21 (72.40%).
2. Of the total number of accredited

testing laboratories for food, in the RS, 25% of them are state-owned and 75% of them are in private ownership, while in the Federation of B&H 66.70% of ALFs are state-owned and 33.30% of ALFs are privately owned. At the level of B&H, 53.80% of accredited testing laboratories for food are state-owned and 43.20% are privately owned. In the Federation of Bosnia and Herzegovina, the tasks of laboratory food safety testings which are of public interest for human health, are performed mostly in accredited state-owned testing laboratories for food, while Republika Srpska, in addition to its own significant (state-owned) laboratory capacity, relies mostly on privately- owned laboratories.

3. Food testing laboratories in Bosnia and Herzegovina have accredited 13 different fields of accreditation related to testing food, animal feed, drinking water and microbiological purity, of which 11 in the Republika Srpska (84.60%) and 13 in the FB&H (100%). At state level, state- owned laboratories are dominant in 76.90% of the fields, in 7.70% the ratio is equal, and privately -owned laboratories are dominant in 15.40% of the fields. 27% of the accredited fields in Republika Srpska are dominated by state-owned laboratories, in 27% of the fields the ratio of laboratories in state and private ownership is the same, 46% of the fields are dominated by privately -owned laboratories, while in the FB&H state-owned laboratories dominate in all accredited fields (100%). State-owned laboratories accredited test methods in all 13 fields (100%), and privately owned ones in 9 fields (69.20%). Privately-owned laboratories have selected fields of accreditation that bring greater profits, as the requirements for these analyzes are more common, and the methodology of work and equipment is simpler.

4. Physicochemical tests of animal feed, testings of residues of veterinary medicinal products, GMO testings and testing of radionuclide activity in food and animal feed in B&H are carried out exclusively in state-owned laboratories. At the B&H level, testing of residues and contaminants in food is performed exclusively by state-owned veterinary laboratories (6.90% of accredited laboratories). Physicochemical testing of animal feed is also exclusively performed in veterinary laboratories (10.30% of accredited laboratories), and these laboratories account for 80% of the microbiological testing of animal feed.

5. B&H has significant capacities of accredited test laboratories for food, their participation in physicochemical food testing is

55.50%, 59.20% in water testing, and 68.90% in microbiological testing of food.

6. No test laboratory for food in B&H has accredited all test methods for testing all physicochemical parameters in food,animal feed and water, or regarding toxicological testing of residues and contaminants in food and residues of veterinary medicinal products, which are prescribed by legislation. From the standpoint of accreditation, the requirements of the legislation are fully met by 6.90% of accredited test laboratories (all state-owned) for microbiological food testing, 20.70% of accredited laboratories for microbiological testing of animal feed, and 10.30% of laboratories for microbiological testing of water. Testings in accordance with the Rulebook on criteria of microbiological purity in the RS were accredited by 12.50% of food testing laboratories (state-owned).

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