

## **ACCURACY OF AC AND AT METHODS IN MILK RECORDING IN THE BALKAN GOATS BREED IN MACEDONIA**

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### **Abstract**

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The aim of this research was to compare the AC and AT methods (as alternative methods) with A4 method (as referent method), for determination of milk production, on the day of recording of the indigenous Balkan goat, in the period of 2014-2016 with milking of goats in the morning and evening. Simultaneously, the influence of the following factors has been tested: year (year of kidding), lactation, month of kidding, milk yield level. It was determined that the largest deviation in the prediction of milk yield according to the AT method during morning milking was determined in 2016 with milk yield underestimated for -5.3 L, whereas the smallest deviation was registered in 2015 with milk yield underestimated for -1.8 L. The largest deviation in the prediction of milk yield according to the AC method during morning milking was determined in goats in first lactation, with milk yield overestimated for +3.8 L, whereas the smallest deviation was determined in goats in fourth lactation with milk yield underestimated for -0.3 L.

With the analysis of all abovementioned factors, it was determined that the AT method is more suitable as alternative and cheaper method for determination of accurate amount of milk.

Key words: Balkan goat, daily lactation, method AT, method AC, predicted daily milk yield

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## Introduction

According to the ICAR regulations, there are few methods (A4, A5, AC and AT) that provide an opportunity for milk recording in goats, during the lactation period. The first two methods (A4 and A5) are used for measurement of milk yield during morning and evening milking on the day of milk recording. If there is third milking in the afternoon, these two methods cover the same.

The AC method is used for measurement of the amount of morning or evening milk, after which a correction coefficient is used for determination of milk yield on the day of test.

The AT method is used for measurement of the amount of morning and evening milk, alternatively (with measurement of morning milk for one month and evening milk the other month), to the end of the milking period, whereby during the calculation of the obtained milk in the day of test, the amount of milk from each milking is doubled.

The aim of this study was to determine the accuracy of two methods for milk recording (AC and AT), and prediction of the actual milking milk yield in the Balkan goats, measured twice a day (according to the standard A4 method), (ICAR, 2009, ICAR, 2012), in the morning and evening. Also we measured different level of milk production of goats.

Regarding the deficit of such testing of goat milk, the comparison and discussion of the results was performed with similar testing, realized in sheep.

**Table 1. Distribution of tested goats by parity per year of kidding**

Year	Lactation									Total
	I	II	III	IV	V	VI	VII	VIII	IX	
2014	84	53	70	26	4	3	2	0	0	242
2015	0	84	53	70	26	4	3	2	0	242
2016	0	0	84	53	70	26	4	3	2	242
Total	84	137	207	149	100	33	9	5	2	726

**Table 2. Individual lactation tests in goats**

Year	Lactation									Total
	I	II	III	IV	V	VI	VII	VIII	IX	
2014-2016	588	882	1318	919	598	195	56	30	12	4598

## Material and Methods

We used a flock of Balkan Goat breed as basic experimental material, located in the South-East part of Republic of Macedonia.

The testing included individual records for measured milk (morning and evening milk) on the day of test of 242 goats, for a period of 3 years (2014-2016), or a total of 726 lactation records, in age from first to ninth lactation (Table 1).

A total of 4598 individual lactation tests were realized during the three years of milk production or according to the age range: 588 tests in first lactation, 882 tests in second lactation, 1318 tests in third lactation, 919 tests in fourth lactation, 598 tests in fifth lactation, 195 tests in sixth lactation, 56 tests in seventh lactation, 30 tests in eighth lactation and 12 tests in ninth lactation (Table 2).

Mainly combined (barn-pasture) system of breeding was used on the farm, which means usage of the available vegetation during almost the entire year, whereas in a certain period of the year, especially in winter, goats were fed additionally with meadow hay (November-February) and concentrate (January-April). Kids stayed with their mothers depending on the purpose. Kids intended for slaughter stayed with their mothers until they were sold for meat (2-2,5 months age), whereas those intended for reproduction, stayed little longer, up to 3 months. The milking period started after the weaning of the kids.

The A4 method was used as an reference method, which means it was used for measurement of daily milk production per goat (morning and evening milk), in the interval from 28 to 34 days.

The testing of milk started after the weaned of the kids and lasted until the moment of drying (between end of October to the middle of November). There were realized a total of 7 milk tests per animal in 2014, 6 milk tests in 2015 and 6 milk tests in 2016.

In order to determine milk yield using the AC method, the total obtained milk was calculated for each day of testing (in the morning and evening), whereby the total amount of milk was obtained (in the morning and evening). In this way the correction coefficient for morning and evening milking was formed and the individual milk yield for the day of test was predicted. The predicted milk yield using the AC and AT method was compared with the actual milk yield (method A4).

In order to determine the influence of the level of milk yield on the accuracy of measurement of total milk per day per goat, the lactations were divided in three groups with equal number: low-productive (1.12-3.60 L), middle-productive (3.60-5.87 L) and highly productive (5.90-18.27 L). Each group consisted of 242 lactations.

With this method, the lactations of certain goats may be included in different groups during certain years of monitoring of milk yield.

The traits of testing were marked as it follows:

- Total – the milk yield measured according to A4 method;
- Predml (Prediction by morning milking) – (milking milk yield by AC method with individual test in the morning);
- Predel (Prediction by evening milking) – (milking milk yield according to the AC method with individual test in the evening);
- Difml (Diference with morning milk) – (difference between AC at morning milking and A4 method);
- Difel (Diference with evening milk) – (difference between AC method at evening milking and A4 method);
- Atfml – (lactation milk yield according to the AT method with first month of test at the morning milking);
- Atfel – (lactation milk yield according to the AT method with first month of test at the evening milking);
- Atdifml – (difference between AT method with first month of test in morning milking and A4 method);

Regarding the abovementioned traits, the influence of the following factors has been tested:

- Year (Year of kidding), (2014, 2015, 2016);
- Lactation (1, 2, 3, 4, 5, 6, 7, 8, 9),
- Month of kidding (December, January, February),

- Milk yield level – groups with level of milk yield according to the A4 method: low – 1/3 of the lactations with lowest milk yield, average – 1/3 of the lactations with average milk yield and high - 1/3 of the lactations with highest milk yield;

- The analyses were performed using the package programs SPSS (SPSS, 1994).

## Results and Discussion

The influence of studied factors (year, lactation, month of kidding and level of milk yield) on the actual, predicted milk yield and the differences between the actual and predicted milk yield are presented in Table 3.

According to the data in the same table, the factor -Level of milk yield had highly significant influence ( $P < 0.001$ ) on almost all traits. This factor had no influence ( $P > 0.05$ ) on the difference between the AT and A4 method during morning milking in the first month of testing (Atdifml).

The year is significant factor on a part of the tested traits and non-significant factor on the remaining traits. For example, this factor had highly significant influence ( $P < 0.001$ ) on milking milk yield according to the A4 method (Total L – milking milk yield according to the A4 method), milking milk yield according to the AT method during evening milking in the first month of testing (Atfel) and on the difference between AT and A4 method during morning milking in the first month of testing (Atdifml).

Lower influence ( $P < 0.01$ ) the year had on the milking milk yield according to the AC method during evening milking (Predel) as well as on the milking milk yield according to the AT method with morning milking in the first month of testing (Atfml).

Significant influence of the year, on the determined and expected daily milk yield (using A4 and AC methods) has been determined in East-Frisian breed of sheep in Macedonia (Pacinovski et al., 2015).

Similar results about the influence of lactation on daily milk production were obtained in Awassi and East-Frisian sheep in Macedonia, (Dimov et al., 2005 and Djabirski et al., 2006).

The factor – year had no influence on the remaining traits (Predml, Difml and Difel). The remaining two factors -Lactation and Month of kidding did not manifest any influence ( $P > 0.05$ ) on any of the tested traits.

Coefficient of determination ( $R^2$ ), showed that the complex of the studied factors determine from 70.3% to 74.1% of the variation of the measured milk yield, and from 8.6% to 9.4% of variation of the difference between the predicted

and total milk yield for the milking only period by the AC method and considerably lower for AT method 1.57% (Table 3). This is maybe the too great variation due to the method of calculation. This indicates, that AT method is more precise in prediction (for Atfml and Atfel) in terms of influence of the environmental factors and so also because of the close values of R2 with Total. Therefore AT method could be proposed for the practice.

The average milk yield measured according to the AC method during morning milking is 157 L, whereas during evening milk is 155.2 L (Table 4). The highest amount of milk yield determined according to the AC method during morning milking was measured in 2014 (162.5 L) whereas the lowest amount was measured in 2016 (151.1 L). The same ratio highest-lowest milk yield per year was determined in milk yield measured according to the AC method, during evening milking. There was no tendency in the year effect on AC prediction; in 2014 the evening test gave higher prediction, while in 2015 and 2016 morning test gave higher prediction. In all measurements the AC method gave somewhat lower measurement vs A4 method.

The difference between the measured and predicted milk yield according to the AC method during morning milking is 0.9 L, whereas the difference between the predicted and measured milk during evening milking is -0.73 L.

Analyzing by year, the largest deviation in the prediction of amount of milk yield according to the AC method during morning milking was determined in 2016 (+2.1 L.), whereas the smallest deviation was registered in 2014 with milk yield was underestimated for -0.9 L. In the prediction of milk yield according to the AC method during evening milking, the largest deviation was registered in 2016, with milk yield underestimated for -1.6 L, whereas the smallest deviation was also registered in 2014, with milk yield overestimated for +0.6 L.

For example, the results obtained at Bulgarian Synthetic Dairy Sheep, show that the total amount of milking milk is slightly decreasing with AC method for 120 days (Ivanova, 2013). Also some results from Awassi sheep in Macedonia show that the correlation between the two methods (A4 and AC) is high, with maximal variations in prediction from 1.9 to 3.4 L, (Gievski et al., 2006).

By using the AC method for prediction of milking milk yield during morning milking in the first month of the testing, the milk yield was 151.9 L, whereas by using the AT method for prediction of milking milk yield during evening milking in the first month of the testing, the milk yield was 160.1 L. The difference between the measured and predicted milk yield using the AC and AT method during morning milking in the first month of the testing was -4.1 L, whereas the difference

during evening milking in the first month of the testing was alternatively +4.1 L.

The largest deviation in the prediction of milk yield according to the AT method during morning milking was determined in 2016 with milk yield underestimated for -5.3 L, whereas the smallest deviation was registered in 2015 with milk yield underestimated for -1.8 L.

Analyzing according to the age i.e. number of lactation, the highest amount of lactation milk yield was determined in goats in seventh lactation (166.8 L), whereas the lowest amount was determined in goats in first lactation (149 L).

The largest deviation in the prediction of milk yield according to the AC method during morning milking was determined in goats in first lactation, with milk yield overestimated for +3.8 L, whereas the smallest deviation was determined in goats in fourth lactation with milk yield underestimated for -0.3 L. The same ratio largest-smallest deviation in milk yield according to the AC method during evening milking was determined in goats in same age (first and fourth lactation).

The largest deviation in the prediction of milk yield according to the AT method during morning milking was determined in goats in fifth lactation (-3.2 L) whereas the smallest deviation was registered in goats in ninth lactation with milk yield underestimated for -0.4 L.

Having in mind that goat kidding is mainly in a period of three months (January-February), the highest amount of milk yield was determined in goats that kidding in February (156.2 L) whereas the lowest amount of milk yield was determined in goats that gave birth in January (155.6 L).

The largest deviation in the prediction of milk yield according to the AC method during morning milking was determined in goats that gave birth in December, with milk yield overestimated for +4.7 L, whereas the smallest deviation was determined in goats that gave birth in January, with milk yield underestimated for 0.7 L.

In relation to the milk yield predicted according to the AC method during evening milking, the largest deviation was registered in goats that gave birth in December (+3.6 L) and the smallest deviation was registered in goats that gave birth in January, with milk yield underestimated for -0.5 L.

In the prediction of milk yield according to the AT method during morning milking, the largest deviation was determined in goats that gave birth in January and February (-3.5 L), whereas the smallest deviation was determined in goats that gave birth in December, with milk yield underestimated for -2.4 L.

Having in mind that we divided goats in three groups according to the amount of milk yield: goats with low, average and high amount of milk yield, the average milk yield in goats with low amount of milk yield is 80.7 L, 143.5 L is the

**Table 3. Influence of factors on the actual, predicted lactation milk yield and the difference between actual and predicted yield of goats**

Source	df	Totall	Predm1	Predel	Difm1	Difel	Atfml	Atfel	Atdifm1
Year	2	***	NS	**	NS	NS	**	***	***
Lactation	8	NS	NS	NS	NS	NS	NS	NS	NS
Month of kidding	2	NS	NS	NS	NS	NS	NS	NS	NS
Milk yield level	2	***	***	***	***	***	***	***	NS
R Squared, %		74.1	70.3	73.8	8.6	9.4	73.9	74.0	1.57

Significance: \*\*\* P<0.001; \*\* P<0.01; \* P<0.05; NS P>0.05

**Table 4. Effects of factors on the actual, predicted lactation milk yield and the difference between actual and predicted yield of goats, Lit.**

Effect	N	Totall	Predm1	Predel	Difm1	Difel	Atfml	Atfel	Atdifm1
Year									
2014	242	173.8	162.5	164.0	-0.9	0.6	158.3	168.5	-5.1
2015	242	165.6	157.0	154.3	1.5	-1.2	153.7	157.4	-1.8
2016	242	158.7	151.1	147.4	2.1	-1.6	143.8	154.3	-5.3
Average, L		166	157	155.2	0.90	-0.73	142	160.1	-4.10
Lactation									
1	84	149.0	152.8	146.1	3.8	-2.9	146.5	151.4	-1.5
2	138	152.0	153.1	151.1	1.2	-0.8	148.6	155.4	-2.7
3	208	154.8	156.3	153.7	1.5	-1.1	151.3	158.2	-2.9
4	149	159.6	159.3	159.8	-0.3	0.2	155.9	163.2	-3.0
5	99	155.4	155.8	155.0	0.4	-0.4	151.4	159.4	-3.2
6	32	157.5	160.3	155.5	2.8	-2.1	154.0	161.1	-2.2
7	9	166.8	165.7	167.5	-1.0	0.7	161.6	171.9	-2.7
8	5	149.7	150.5	148.9	0.8	-0.7	144.5	154.9	-1.9
9	2	159.1	158.0	159.5	-1.0	0.5	153.4	164.7	-0.4

Table 4. Continued

Average, L		156	157	155.2	0.91	-6.6	152	160	-2.28
Month of kidding									
12	74	156.1	160.9	152.5	4.7	-3.6	152.6	159.6	-2.4
1	490	155.6	154.8	156.1	-0.7	0.5	151.3	159.9	-3.5
2	162	156.2	154.9	157.1	-1.3	0.9	151.8	160.6	-3.5
Average, L		156	157	155.2	2.70	-2.20	152	160	-3.13
Milk yield level									
Low	242	80.7	79.0	82.2	-1.7	1.5	76.8	84.6	-3.0
Middle	242	143.5	140.9	145.4	-2.5	1.9	139.4	147.5	-3.1
High	242	243.7	250.7	238.1	7.0	-5.7	239.5	248.0	-3.3
Average, L		156	157	155.2	2.80	-2.3	152	160	-3.13

average amount of milk yield in goats with average amount of milk yield and 243.7 L is the average amount of milk yield in goats with high amount of milk yield.

Analogous to the level of milk yield (low, average and high), the largest i.e. smallest deviation in the prediction of milk yield according to the AC method was determined during morning milking (+4.7 and -0.7 L) but also during evening milking (+3.6 and -0.5 L).

In the prediction of milk yield according to the AT method during morning milking the largest deviation was determined in goats with low level of milk yield, with milk yield underestimated for -3.0 L.

## Conclusions

Based on the conducted tests, the following can be concluded:

- AT method gives slightly better prediction of the milk yield for milking only period and is less influenced by the year, age and production level,
- It was determined that the largest deviation in the prediction of milk yield according to the AT method during morning milking was determined in 2016 with milk yield underestimated for -5.3 L, whereas the smallest deviation was registered in 2015 with milk yield underestimated for -1.8 L.

- The largest deviation in the prediction of milk yield according to the AC method during morning milking was determined in goats in first lactation, with milk yield overestimated for +3.8 L, whereas the smallest deviation was determined in goats in fourth lactation with milk yield underestimated for -0.3 L.

- Therefore, the general conclusion is that the AT method is more suitable as alternative and cheaper method for determination of accurate amount of milk.

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