

## **Influence of altitude, lactation period and ripening on Sharri cheese composition**

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### **Abstract**

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Sharri cheese is the indigenous most represented and affirmed cheese in Kosovo. Autochtony production of this cheese is characterized by ripening in the brine solution, which ensures the anaerobic condition of ripening and contributes to creating sensory characteristics. The objective of this work was the evaluation the influence of altitude, the month of the lactation period, and the ripening period on changes in the basic composition of Sharri cheese produced in the Sharri region. Sharri cheese is produced in farm batches in two different areas of the Sharri region (Brod, altitude 1600 m., – Variant A and Prevallë, altitude 1200 m. – Variant B). Five cheese producers have been selected in each area. Sharri cheese is produced once per month, during June, July, August, and September. Produced cheese in this research has been ripened in a brine solution in the period of 5 months (150 days). During this time, movement of each parameter (TS-Total solids), Fat, Proteins (P), Lactose (L), Ash, Titratable acidity (TA), and Active acidity – AA (pH), is analyzed on the day 1, 7, 15, 30, 60, 90, 120 and 150 of ripening. Cheese produced in two different altitudes generally showed good quality composition. Based on these results, altitude has had a significant influence ( $P < 0.0001$ ) on TS, Fat, P, and TA, whereas a non-significant influence on NaCl, Ash, and AA. Period of lactation showed significant differences on TS, Fat, P Ash, and TA, whereas non-significant differences on NaCl and AA. During the 150-day ripening period, all values of cheese ingredients have increased significantly ( $P < 0.0001$ ). Thus, it can be concluded that the ripening period has significantly affected the change of all ingredients of produced Sharri cheese.

*Keywords:* Sharri cheese, Altitude, lactation period, ripening

### **Introduction**

Sharri cheese is indigenous most represented and affirmed cheeses in Kosovo. According to Bernard-Mongin et al. (2021), Sharri Cheese is defined as a seasonal hard sheep's cheese produced between April and October from whole sheep's milk. Moreover, it can be produced as a soft cheese and either from cow and mixed milk. It is traditionally produced in the mountainous areas of the Sharri region,

which includes the municipalities of Prizren, Dragash and Shtërpçë. According to Meleqi (2013), Sharri region distinguished by water potential, then with quality pastures that are very good basis for the development of livestock, drug and aromatic industry, mountain tourism etc.

Studies related to the production and quality of Sharri cheese are few. They offer extensive opportunities for the recognition of suitable processes and parameters in the technology of transformation of indigenous sheep milk transfor-

mation, production of quality cheeses and nutritional value and quality assurance in dairy technology. However, some efforts, sponsored by the French Embassy in Kosovo (<http://www.ksiip.com/seminar-with-sharri-cheese-association-in-prizren/>), Ministry of Agriculture, Forestry and Rural Development (MAFRD) and various scientific researches, have been made available to contribute to identify the product specifications of the Sharri Cheese – soon to be protected as Geographical Indications. Autochtony production of Sharri cheese is characterised by ripening in brine solution. According to Soda et al. (2011), ripening in brine has a determinable effect on biochemical, textural, and structural changes that occur in these cheeses and lead to the development of their characteristic flavor and texture. McSweeney (2004); Cruz et al. (2009); and Pagthinathan Nafees (2015) enumerate the three primary processes in the ripening mechanism of cheese of different intensities, which are created by the fermentation of lactose (glycolysis), the hydrolysis of milk fat (lipolysis) and the breakdown of proteins (proteolysis). These processes according to Sousa et al. (2001) are mainly responsible for changes in the texture of cheese, for the formation of the basic taste and aroma of cheese that occur during ripening, but they are also responsible for numerous secondary changes and reactions, which create precise nuances of taste and cheese texture.

The objective of this work was the evaluation of influence of altitude, month of lactation period and ripening period on changes in basic chemical composition of Sharri cheese produced in Sharri region.

## Material and Methods

Sharri cheese is produced in farm batches in two different areas of Sharri region: Brod (latitude: 41° 59' 30.84" N, Longitude: 20° 42' 21.96" W and altitude 1600 m – Variant A), and Prevallë (Latitude: 42° 12' 22.57" N, Longitude: 20° 58' 26.15" E and altitude 1200 m – Variant B). Five cheese producers have been selected in each area. The cheese is produced in each area traditionally, during the months of June, July, August and September, using specific procedures which in some cases have had certain differences (described in production procedure). Sheep milk, full fat and unpasteurized, in amount of 20 lit., immediately after milking was filtered on multilayer cloth. At 42°C (Variant A), or at the post-milking temperature (variant B) the rennet (Chy-max in variant A and liquid rennet named Majë djathi in variant B) is added, mixed and after 30-40 min a strong curd is formed. The curd is cut (finely crushed) and left for 10 minutes for drainage of whey. The remaining curd was treated with 60-70°C hot water, mixed and processed by hand in order to

remove whey. The curd is placed on a cheese cloth for molding where is poured with hot water at a temperature of 60-70°C to help draining whey. Afterwards, the formed cheese curd is hunged and a quantity of hot water is added again to help removing the whey. The hanged cheese stayed on on the cheese cloth all day and night. Next day cheese is placed on a wooden shelf (Figure 1), for 7-10 day until obtaining a yellow color. Then, the cheese is cut with a knife (Variant A) or by hand (Variant B) into small pieces (200-300 gr) and packaged into plastic jars, where dry salting is done for two day. Afterwards, for better sensory properties, pieces of Dill plant (lat. *Anethum graveolens*) are added in both variants. Finally, the 25% pre-boiled, filtered, and cooled brine solution added into the cheese. The packaged cheese after adding brine solution (Figure 2) is placed in a dry and cool place



Fig. 1.



Fig. 2.

over a period of 150 days for ripening and storage, and then used for consumption.

Produced cheese in this research has been ripened in brine solution in the period of 5 month (150 day). During this time, movement of each parameter (TS, Fat, P, Ash, TA and AA, is analyzed on the day 1, 7, 15, 30, 60, 90, 120 and 150 of ripening.

The cheese samples were taken according to IDF Standards 50 B: 1985 (Grüner & Filajdić, 1993). In a total of 320 cheese samples, the following parameters were analysed: TS content by drying method in 105°C (ISO 5534/2004); Fat content by Van Gulik-Gerber method (ISO 3433/2008); P content by Kjeldahl method (ISO 8968-1-2014); ash content by burning method in 550-600°C (AOAC, 2005); NaCl content by Mohr method (AOAC 935.43, 33.7.10: 2000); TA value by Soxhlet-Henkel method and AA value by ISO 11869 (2012). All cheese samples were analysed in triplicate in the laboratory of Food Technology in Faculty of Agriculture and Veterinary in Prishtina. Results were statistically analyzed using JMP-IN 7.0 statistical package (SASS unit). The results of the analyzes are presented in tabulatory form, and the statistical processing of the obtained results included determining the Mean value, SEM value, and the P value of the significance between analyzed samples.

## Results and Discussion

From the results presented in Table 1, can be seen that the chemical and physical composition of the Sharri cheese has been good and suitable for the consumption. Cheese produced in two different altitudes generally showed good quality composition. Higher content with statistically significant differences ( $P < 0.0001$ ) of TS, Fat, P, and TA, were shown in cheese produced in altitude of 1600 m, respectively 67.16%, 28.01%, 25.40% and 51.53°SH, compared to cheese produced in altitude of 1200 m (63.90%, 26.54%, 23.46% and 5.00). On the other hand, almost the same value (5.21% in in altitude of 1600 m and 5.24% in altitude of 1200 m), with non-significant differences were carried out for NaCl content. Mean values for Ash content and pH value ranged respectively from 6.11 to 5.67%, with statistically non-significant differences and 5.20 to 5.00, also with statistically non-significant differences. Based on these results, it can be concluded that altitude has had an influence on TS, Fat, P, and TA whereas in NaCl, Ash and AA didn't showed any influence of the cheese produced.

Sharri cheese composition during lactation period is presented in Table 2.

**Table 1. Sharri cheese composition at different altitudes (n = 320)**

Parameters	Altitude (Mean ± SEM)		Total (A+B)	Difference (A-B)	P value
	A	B			
TS (%)	67.16 ± 0.29 <sup>a</sup>	63.90 ± 0.18 <sup>b</sup>	65.53 ± 0.19	4,85	<0.0001
Fat (%)	28.01 ± 0.16 <sup>a</sup>	26.54 ± 0.17 <sup>b</sup>	27.28 ± 0.12	5,25	<0.0001
P (%)	25.40 ± 0.14 <sup>a</sup>	23.46 ± 0.18 <sup>b</sup>	24.43 ± 0.12	7,64	<0.0001
NaCl (%)	5.21 ± 0.07 <sup>a</sup>	5.24 ± 0.08 <sup>a</sup>	5.23 ± 0.05	0,58	(ns)
Ash (%)	6.11 ± 0.09	5.67 ± 0.08	5.89 ± 0.06	7,20	(ns)
TA (°SH)	51.53 ± 0.57 <sup>a</sup>	48.56 ± 0.47 <sup>b</sup>	50.05 ± 0.38	5,76	<0.0001
AA (pH)	5.20 ± 0.03	5.00 ± 0.04	5.10 ± 0.03	3,85	(ns)

Values are presented as mean ± standard deviation; TS-Total Solids, P-Proteins, Ash, TA-Titratable acidity, AA-Active acidity (pH); <sup>a, b</sup> Means with different letters in superscript in each column and row are significantly different ( $P < 0.05$ )

**Table 2. Sharri cheese composition during lactation period (n = 320)**

Parameters	Month of lactation period (Mean ± SEM)					P value
	June	July	August	September	Difference, % (June-September)	
TS (%)	63.81±0.30 <sup>c</sup>	64.48±0.34 <sup>c</sup>	66.22± 0.41 <sup>b</sup>	67.60±0.35 <sup>a</sup>	5,61	<0.0001
Fat (%)	25.99±0.19 <sup>c</sup>	27.12±0.24 <sup>b</sup>	27.67±0.25 <sup>b</sup>	28.31±0.22 <sup>a</sup>	8,19	<0.0001
P (%)	23.07±0.24 <sup>d</sup>	23.83± 0.22 <sup>c</sup>	25.06±0.20 <sup>b</sup>	25.76±0.22 <sup>a</sup>	10,44	<0.0001
NaCl (%)	5.10±0.10	5.04±0.09	5.28±0.11	5.48±0.10	6,93	(ns)
Ash (%)	5.59±0.11 <sup>b</sup>	5.43±0.10 <sup>b</sup>	6.11±0.12 <sup>a</sup>	6.42±0.13 <sup>a</sup>	12,93	<0.0001
TA (°SH)	47.45±0.53 <sup>c</sup>	48.03±0.60 <sup>c</sup>	51.27±0.74 <sup>b</sup>	53.44±0.91 <sup>a</sup>	11,21	<0.0001
AA (pH)	5.04±0.05	5.13±0.05	5.05±0.06	5.18±0.06	2,70	(ns)

Values are presented as mean ± standard deviation; TS-Total Solids, P-Proteins, Ash, TA-Titratable acidity, AA-Active acidity (pH); <sup>a, b, c, d</sup> Means with different letters in superscript in each column and row are significantly different ( $P < 0.05$ )

**Table 3. Sharri cheese composition during ripening (n=320)**

Parameters	Days of ripening (Mean ± SEM)										Mean	Difference, % (1-150)	P value
	1	7	15	30	60	90	120	150					
TS (%)	62.53 ± 0.28 <sup>g</sup>	63.10 ± 0.35 <sup>fg</sup>	63.98 ± 0.34 <sup>ef</sup>	65.06 ± 0.40 <sup>de</sup>	66.09 ± 0.47 <sup>cd</sup>	66.95 ± 0.51 <sup>bc</sup>	67.81 ± 0.55 <sup>ab</sup>	68.70 ± 0.56 <sup>a</sup>	65.53	8,98	<0.0001		
Fat (%)	25.03 ± 0.20 <sup>g</sup>	25.56 ± 0.23 <sup>fg</sup>	26.09 ± 0.23 <sup>f</sup>	26.84 ± 0.23 <sup>e</sup>	27.59 ± 0.25 <sup>d</sup>	28.30 ± 0.25 <sup>c</sup>	29.00 ± 0.28 <sup>b</sup>	29.78 ± 0.29 <sup>a</sup>	27,27	15,95	<0.0001		
P (%)	22.52 ± 0.29 <sup>g</sup>	23.09 ± 0.29 <sup>fg</sup>	23.80 ± 0.31 <sup>ef</sup>	24.27 ± 0.31 <sup>de</sup>	24.74 ± 0.33 <sup>cd</sup>	25.24 ± 0.30 <sup>bc</sup>	25.63 ± 0.27 <sup>ab</sup>	26.16 ± 0.29 <sup>a</sup>	24,43	13,91	<0.0001		
NaCl (%)	4.31 ± 0.10 <sup>f</sup>	4.48 ± 0.09 <sup>f</sup>	4.79 ± 0.08 <sup>e</sup>	5.02 ± 0.08 <sup>e</sup>	5.35 ± 0.09 <sup>d</sup>	5.63 ± 0.09 <sup>c</sup>	5.95 ± 0.13 <sup>b</sup>	6.28 ± 0.14 <sup>a</sup>	5,23	31,37	<0.0001		
Ash (%)	4.73 ± 0.10 <sup>e</sup>	5.09 ± 0.12 <sup>d</sup>	5.29 ± 0.12 <sup>d</sup>	5.72 ± 0.14 <sup>c</sup>	6.02 ± 0.11 <sup>c</sup>	6.44 ± 0.13 <sup>b</sup>	6.77 ± 0.13 <sup>ab</sup>	7.07 ± 0.14 <sup>a</sup>	5,89	33,10	<0.0001		
TA (°SH)	44.75 ± 0.72 <sup>f</sup>	45.84 ± 0.81 <sup>ef</sup>	47.43 ± 1.04 <sup>de</sup>	49.13 ± 1.06 <sup>cd</sup>	51.27 ± 0.99 <sup>bc</sup>	53.03 ± 0.85 <sup>ab</sup>	53.71 ± 0.87 <sup>ab</sup>	55.20 ± 0.93 <sup>a</sup>	50,05	18,93	<0.0001		
AA (pH)	4.42 ± 0.03 <sup>g</sup>	4.61 ± 0.04 <sup>f</sup>	4.88 ± 0.04 <sup>e</sup>	5.04 ± 0.04 <sup>d</sup>	5.31 ± 0.05 <sup>c</sup>	5.42 ± 0.06 <sup>bc</sup>	5.51 ± 0.05 <sup>ab</sup>	7.07 ± 0.14 <sup>a</sup>	5,10	21,21	<0.0001		

Values are presented as mean ± standard deviation; TS-Total Solids (%), P-Proteins (%), TA-Titratable acidity (°SH), AA-Active acidity (pH). <sup>a,b,c,d,e,f,g</sup> Means with different letters in superscript in each column and row are significantly different (P < 0.05)

Sharri cheese produced in different periods during lactation period (Table 2), has had good composition, which is presented through chemical parameters.

TS in cheese during lactation period increased significantly for 5.61% (P < 0.0001) from 63.81% in June to 67.60% in September. The Sharri cheese is characterized by relatively high fat content, which mainly has been influenced by composition of used milk. Fat content of the Sharri cheese during lactation period has had a considerable change. Significant differences (8.19%) between months of lactation period (P < 0.0001) can be seen for this parameter, respectively from 25.99% to 28.31%.

Protein content of cheese, in the end had a higher value for 10.44% compared to beginning of lactation period, respectively 25.76% and 23.07%. Protein content of cheese showed statistically significant differences (P < 0.0001) between months of lactation period.

NaCl content in cheese samples was relatively stable during lactation period. This parameter ranged between 5.10% to 6.42%. Even though differences between months of lactation period were 6.93%, these were statistically non-significant.

Significant differences (P < 0.0001) are carried out for Ash content. There is a noticed increase of values for 12.93%, from 5.59% in the first month, to 6.42% in the last month of cheese production.

Titratable acidity value showed significant differences between months of lactation period. Values of this parameter increase significantly for 11.21% (P < 0.0001), from 47.45% in June, up to 53.44% to September.

In the first month of lactation period, Active acidity showed a slightly lower value (5.04) compared to the last month (5.18), with non-significant differences for 2.70% between months. Generally, it can be concluded that increase of TS, Fat, P, and Ash was with significant differences (P < 0.0001) during months of lactation period, whereas increase of NaCl and AA were not noticed to be significant.

### Sharri cheese composition during ripening

Sharri cheese composition and movement of quality parameters during the period of ripening is presented in Table 3.

Ripened Sharri cheese had a relatively high content of total solids (65.53%, Table 3). Generally, the high content of total solids in Sharri cheese is as a result of the high content of this parameter in milk. Total solids of cheese was 62.53% and reached the maximum on the end of this investigation (68.70%), with an mean value of 65.53%. Increase of this parameter during lactation period was significant (P < 0.001) with 8.98%.

Our results for the total solids movement during ripening are consistent with those of Licitra et al. (2000), who have studied the composition of Regusano cheese ( $n = 132$ ) during 12 months of ripening and have found that TS rised from 54.65% to 66.40%. Bakirci et al. (2011) concluded slightly increase of the TS in samples of Turkish white pickled cheese during storage, but without significant differences ( $P > 0.05$ ). Topçu & Saldamli (2006) concluded that total solids in Turkish White Cheese increased during 90 days of ripening from 39.80-41.12%. The similar conclusion related to increase of TS content throughout the storage period emphasized Papetti & Carelli (2013) in a total of 23 cheeses of Caciottina massaggiata di Amaseno. Completely opposite flow on the dynamics of this parameter movement during 279 days of cheese ripening in autochtonous Macedonian beaten cheese found Slaveska (1985) which concluded reduction of TS from 65.50% to 57.00%. The results of our investigation are evidently higher in compare with results obtained from Kapac-Parkačeva et al. (1974) for beaten cheese on the value of 61.59%, and Micev (1966) for Sharri cheese (54.26%). Moreover, evidently lower mean value of TS in compare with our research reported Dozet (1957) on the cheese produced by sheep milk of Merino and Duba bread (50.71 respectively 50.35%), Dozet (1963) in the ripened Travnik cheese, produced by sheep milk, (48.91-50.24%) and Dozet et al. (1968) in the Travnik cheese (48.11%).

Milk fat content significantly affects on the cheese yield, chemical composition and physical properties. The results of this investigation shows significantly high differences ( $P < 0.0001$ ) of the fat content in the end of ripening period, as compared with the start respectively. It is noticed that lower content of fat was in the start of ripening period (25.03 %), then during continous ripening period has shown an consistency increase tendency. In the last day of this period, fat has reached its maximum (29.78%). The rise between start and end of ripening period was about 16%. Increase of the fat content during the period of ripening in our research is in considerable conformity with the results obtained by Licitra et al. (2000) in Regusano cheese, who have found increase of fat content during 12 months of ripening from 25.4% up to about 30.0%. The approximate lower values with our results gained Dozet (1963) on the ripened Travnik cheese (22.43-27.42%), then Micev, (1966) on the Sharri cheese (20.18%), Dozet et al. (1968) on the ripened Travnik cheese (24.17%) and Kapac-Parkačeva et al. (1974) in the beaten cheese (25.30%). On the other hand, Our research results are not consistent with Slaveska (1985), which during 279 days of ripening and storage in Macedonian beaten cheese found opposite flow on decreasing of fat content from 30.30% at the start, up to 23.50% at the end of the research.

Having in regard that the largest change during the ripening of cheese undergoes proteins, often the means of the ripening process is consider their decomposition. Changing of proteins influence on the cheese properties. They resolved during ripening in various products (nitrogenous substances soluble in water, etc.), which influence on the sensory properties of ripened cheese. The total protein content on the analysed samples of Sharri cheese has had a permanent tendency of progressive increase during ripening period for about 14%. The differences between the lower value of this parameter, wich is constated on the June (22.52%) and the higher value, constated on the August (26.16%), has been significantly high ( $P < 0.0001$ ). Protein content in Sharri cheese in our investigation was higher in compare with mean values reported by Dozet (1957) on the cheese produced by Merino (17.045%) and Duba (18.68%) sheep milk. The approximately results with ours have reported Micev (1966) on the Sharri cheese (23.84%) and Kapac-Parkačeva et al. (1974) on the beaten cheese (25.49%). Licitra et al. (2000) in Regusano cheese during 12 months of ripening reported 25.3% at the start and 29.2% of protein and at the end of this period. Our results regarding to positive movement of increase the protein content are consistent with those found in their paper these authors. On the other site, Öner & Sarıdağ (2018) concluded in the Beyaz (White) Cheese produced from sheep milk during 9 month of ripening the total protein content reduction.

NaCl content in Sharri cheese is considered relatively high, and for a hugde number of consumers, one properties wich is unlowable for consumption. The high content of the salt in Sharri cheese is as a results of higher dosage of salt in brine solution due to long term conservation. The results of this investigation shows significantly differences ( $P < 0.0001$ ) of the NaCl content during ripening period (4.31% to 6.28%) with level of changes of 31.37%. Many other types of the cheeses in the brine solution have high content of the salt. Thus, Dozet, (1957) in her investigations on the cheese, produced by Merino sheep milk has constated salt on relatively similar amount in compare with ours (6.17%). The relatively higher salt values have gained in their research Micev (1966) in the Sharri cheese (7.93%), then Kapac-Parkačeva et al. (1974) on the beaten Macedonian cheese (6.75%) and Slaveska (1985) on the autochtonous Macedonian beaten cheese during 279 days of ripening (4.90-8.00%). Significant changes in salt content ( $P < 0.001$ ) during 240 days of Sheep Cheese of ripening observed Estrada et al. (2019). Pavia et al. (2000) suggested that the salt penetration was almost completed within 14 to 30 days of ripening. Etünkaya & Soyutemüz (2006) reported increase of the salt content in total solids of Kashar cheese

from 3.37%-3.72% to 4.97%-5.23% during ripening the 120 days and justified that it could be due to the increase in total solids content. According to Kapac-Parkačeva (1988), the high content of salt 5-10% in a beaten cheese allowed to be consumed in small amounts by the poor population was reason to get the name "sirotinsko sirenje" (cheese for poor). In the future should be working more, in the direction of cheese production with lower salt content, in order to be accepted by wide categories of consumers.

The significantly high differences ( $P < 0.0001$ ) showed Ash content in the end of ripening period (7.07%), as compared with the start (4.73%) respectively. The level of changes between start and end of ripening period was relatively high (33.10%). Bakirci et al. (2011) in White pickled cheese during 90 day of ripening, stated significant differences of Ash content from 7.54% to 9.75% and explained by influences of the moisture loss from the cheese samples along storage time and salt concentrations used. Kapac-Parkačeva et al. (1974) on the beaten cheese have found ash content in the amount of 3.08%, which is a much lower compared with the values obtained in our research. On the other hand, Dimitrovska et al. (2017) in "Bieno" cheese after 45 days of ripening, has reported ash content on value of 9.25%, which is much higher to our results.

During ripening period, level of acidity plays great role through impact in the growth of microorganism and enzymatic activity respectively. The lowest value of TA was recorded in first day of the ripening (44.75°SH) and higher (55.20°SH). This parameter increased significantly ( $P < 0.0001$ ) with level of changes for about 19%.

Active acidity value in this research increased significantly ( $P < 0.0001$ ) from 4.42 to 5.61. A similar trend of increase in the acidity of cheese was reported by Warsama et al. (2006) and justified probably due to the growth of lactic acid bacteria in cheese. The lactic acid not only contributes to the taste of fresh cheese but also improves the cheese structure and protects it against a kind of microbiological spoilage (Turkoglu et al., 2003). Plessas et al. (2021) reported significantly decrease ( $P < 0.05$ ) of pH during the ripening period of the cheeses and emphasized that the pH value of cheese samples were significantly affected by the ripening time and the type of the starter culture that was used for the production of the cheeses. Rotaru et al. (2008) stated that pH evolution is related to lactose fermentation intensity and the acidity increase, but it is also influenced by buffer substances present in cheese. Relatively similar with our results reported in their research Kapac-Parkačeva et al. (1974) in beaten cheese, from region Mariova (5.28 to 5.65) on mean value of 5.04; Prpić et al. (2003) in Krčki cheese with value of 5.78 and Dubrova Mateva et al. (2008) in beaten cheese produced

by genetic rennet on 45 th day of the ripening (pH 5.24) and produced using combined rennet (pH 5.17).

## Conclusions

Cheese produced in two different altitudes generally showed good quality composition. Based on these results, altitude has had significant influence ( $P < 0.0001$ ) on TS, Fat, P, and TA, whereas non significant influence on NaCl, Ash and AA. Period of lactation showed significant differences on TS, Fat, P Ash, and TA, whereas non significant differences on NaCl and AA. During the 150 days of ripening period, all values of cheese ingredients have increased significantly ( $P < 0.0001$ ). Thus, it can be concluded that the ripening period has significantly affected the change of all ingredients of produced Sharri cheese.

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