

gv'cn, 2005). Kp"vj g'r tqf wexkp"qh'htgij 'i qcv'u'e] ggug.'i qcv'o km'gej pqm] kcm' "f qgupø" fall behind cow's milk, except for the separation of small fat droplets in the whey, slower coagulation and softer rennet coagulated gel. However, this property contributes to the softness and characteristic properties of goat cheeses. Goat's milk casein with rennet enzyme gives a less solid curd than cow's and sheep's milk, and is better and easier to digest, which contributes to better digestibility (Dozet gv'cn 2005). Such production characteristics of the goat and favorable physico-chemical, nutritional and technological properties have influenced that goat's milk is predominantly processed into cheese today. Therefore, cheese is the basic product of goat's milk (Uctk & Brenjo, 2022). About 140 types of goat cheese are produced in the world (Rubino gv'cn, 2004; Zervas & Tsiplakou, 2013). The processing of goat's milk into cheese has a very long tradition, and goat's cheese was, and still is, an important element in the population's diet. Goat cheeses have been known since ancient times and were an important element in the diet of the inhabitants (Dozet gv'cn, 2004). The origin of goat cheeses is Mesopotamia and their production spread especially in the Mediterranean countries (Greece, Turkey, Syria, Israel, Iraq and also Iran) (Kosikowski, 1986). The milk was probably originally processed into soft cheeses and then into hard mature cheeses (Park & Hanlein, 2010). In the households, the traditional method of production based on old, original, traditional recipes was preserved, from which different types of cwqej vj qpqwu"i qcv'e] ggugu."ej ctcevgtk'k' "hqt"egt'wkp"ctgcu."y gtg"etgcvf "Dqfcpk "gv'cn 2002; 2018). Over time, the production of goat cheeses in a semi-industrial manner in smaller capacity plants had appeared and they became popular and sought after due to their quality. These cheeses have retained the characteristics of goat's milk with better hygienic production conditions required by modern dairying. One such cheese is the hard, full-fat Lider cheese, which is produced from pasteurized goat's milk at the family hcto "ōO k'cpk ō"kp"vj g'o qwp'wkp'qwu"ctgc"qh'P km-k "o wplekr cks'."O qpvgpi tq0Vj gtg'ku" no much information about this cheese in the literature except in the recent work rwdikuj gf"d{"Dctc "gv'cn (2024). Therefore, the aim of this work is to present the technology, chemical composition, physical and sensory properties of this cheese.

O CVGTCNU'CPF'O GVJ QFU'

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In the research, Lider goat cheese technology was monitored and cheese samples were taken from 3 different production days after 21 days of ripening, which represents the usual ripening period of this cheese. The chemical composition of Lider cheese (g/100g) was examined: dry matter by drying in oven at $102 \pm 2^\circ\text{C}$ (ISO 5534:2004), fat by Van Gulik method (ISO 3433:2008), proteins using Kjeldahl method (ISO 8968-1:2014), salt by the potentiometric method using the device *OM''K'ej rqt kf g"Cpcr' | gt"; 48."* Uj gty qqf and lactic acid by titration (AOAC, 1995). By calculation were determined (%): fat on dry basis - FDB (Bylund, 1995), moisture on fat-free basis ó MFFB (CODEX ALLIMENTARIUS, 1978) and salt in moisture ó S/M (Scott, 1998; Guinee & Fox, 2004). Following physical properties of cheese were analyzed: pH (pH-meter *Ogt qj o "* 854), water activity - a_w (*Tqvt qpk+*"texture (*VCZV''Rnu''Vgz.wt g"Cpcr' ugt +* rind thickness (mm), cross-sectional height (mm) and cross-sectional area ($\text{cm}^2/100\text{g}$) as

well as density (g/ml) *Tc-gxk "gv'crl"4239=Qtcu("Qtw gxk "fiwlgxk ."4246-0'Vj g" results for texture obtained by *VCOZ'Rnu'Vgzwt g'Cpcrl'ugt* in this paper are expressed in N (1N = 101.97g-force, Stable Micro Systems, UK). The sensory evaluation of the cheese was carried out by an expert panel using a point scale of a maximum of 20 points. The data were statistically processed. In order to examine influence of day-by-day variations in milk composition and applied technology to cheese properties one-way analysis of variance and Tukey post-hoc *guv** ($p < 0.05$) were done (Hammer *gv'crl* 2001).

'' TGUNVUCPF'FKE WUKP'' ''

Vj g'hcó kñ 'hcto '\$O klcpk \$'y cu'hqwpf gf 'k'4234."cpf 'yj g'r tqeguakpi "qh'b kmlkpv'ej ggug" dgi cp"kp"42360'F ckt { "ku'r rceg' "cv'mqecvqp" I qtplg"r qrlg."P km-k ."O qpvgpgi tq0I qcv' cheeses are the main product of this company, and among them Lider goat cheese is certainly the most important one. Lider cheese is a hard, full-fat cheese produced from pasteurized goat's milk obtained from goats that are raised in the mountainous area of P km-k ONkf gt 'ej ggug'gej pqmi { 'ku'dcugf 'qp 'yj g'wug'qhl' cuvgwk gf 'wpunko o gf 'i qcv'b kkk with the addition of selected bacterial cultures (Figures 1- 4). Ex-farm milk is cooled and stored to temperatures from 3 to 4°C. The milk is pasteurized at a temperature of 63°C for 30 minutes. After cooling to a temperature of 33°C, CaCl₂, lyophilized starter culture (DELVO TEC, DX-33C DSL DSM Food Specialities consisted of mesophylic lactic acid bacteria *Nceveqeewu'rveku'ssp0rveku'* and *'ssp0et go qt ku.'Nceveqeewu'rveku'* *ssp0rveku'* biovar *Of kcegl' rveku.'Ngweppquqe'* spp.) and rennet (*šO czk gpõ.'F UO 'Hqgf'* Specialities, 1g to 100L of milk) are added. Upon coagulation of milk the curd is cut and heated at a temperature of 36-38°C. The curd is not subjected to pre-pressing, but is immediately poured into the tub, where the molds are manually filled.

Pressing lasts for 12 hours (the cheese is turned over 4 times at the beginning, on average every hour, and the load is 5 kg per tube). Brining is method of salting. The brine was made from whey and consist of 16% salt in which the cheese is soaked for 24 hours. The ripening of the cheeses takes place at a temperature of 11-12°C and a humidity of 65-70% for 30 days but usually the cheese ripening is shorter, 21 days. The weight of the cheese after pressing is 720-820g while after ripening it is sold with average weight of 550g. Very often, depending of requirement of distribution, Lider cheese is vacuum sealed (Figure 5) before ripening. In that case it has longer ripening, somewhat softer consistency and can be classified into category of semi-hard cheeses.

Ceeqtf kpi "q'Dklgrlce"("Uctk "4227+'j ctf "i qcv'ej ggugu'ctg'uo cmgt."y kj "f kco gvg' "33-15 cm and height 3-5 cm. In Balkan countries goat cheeses appear usually in categories of white brined, semi-hard or hard ones. Hard and semi-hard cheeses are usually small and their weights are between 60 g and 1.5 kg (Dozet *gv'cn*, 2004). This is consistent with results obtained in this work.



Figure 1. Filling of molds with curd



Figure 2. Pressing of curd



Figures 3. and 4. Brining and ripening of Lider cheese



Figure 5. Vacuum sealed Lider cheese

In this work chemical composition, physical and sensory properties of Lider cheese are tested. They are shown in following tables.

Table 1. Chemical composition of goat cheese Lider

Component (g/100g)	Production day			Xs	Min.	Max.	St. Dev.	CV (%)
	1	2	3					
Dry matter	60.73 ^a	62.20 ^b	62.64 ^c	61.85	60.73	62.64	1.00	1.62
Fat	29.00 ^a	30.50 ^b	31.00 ^c	30.17	29.00	31.00	1.04	3.45
FDB* (%)	47.99 ^a	49.27 ^b	49.56 ^c	48.94	47.99	49.56	0.83	1.69
MFFB** (%)	55.21 ^c	54.22 ^b	53.82 ^a	54.42	53.82	55.21	0.72	1.32
Proteins	27.15 ^a	27.30 ^b	28.33 ^c	27.59	27.15	28.33	0.64	2.32
Salt	4.53 ^c	4.35 ^b	3.00 ^a	3.96	3.00	4.53	0.84	21.21
S/M (%)***	12.14 ^b	12.10 ^b	8.43 ^a	10.89	8.43	12.14	2.13	19.56
Lactic acid	0.132 ^a	0.199 ^b	0.226 ^c	0.185	0.132	0.226	0.05	27.03

*a-c Different small letters in the columns show statistically significant differences in the values of the examined chemical parameters in the goat cheese samples depending on the production day; *FDB-fat on dry basis; **MFFB ó moisture on fat-free basis; ***S/M-salt in moisture

Content of dry matter, fat, FDB and MFFB were typical for hard, full-fat cheese. These xcnvgu'ctg'ulo krt'q'j qug'tgr qtvf'd{ 'Dctc "gv'cn (2024) for Lider cheese after 15 and 30 days of ripening. Chemical composition for hard goat cheese from Balcan countries is following (%): dry matter 67.21; fat 32.94; FDB 48.78; proteins 29.51 and salt 3.35 (Dozet gv'crl)3; ; 8=DKlgrlce" 'Uctk .'4227-0'Eqpvgpvqhlrxcvke'cefk'y cu'twr r tkpuki n' 'hqy "

but corresponding to relatively high pH (Table 2). One-way analysis of variance revealed that there is a statistically significant influence of the experimental factor (production day) on all examined chemical parameters of goat cheese ($p < 0.05$).

Table 2. Physical properties of goat cheese Lider

Property	Production day			Xs	Min.	Max.	St. Dev.	CV (%)
	1	2	3					
pH	5.50 ^a	5.11 ^b	5.15 ^b	5.25	5.11	5.50	0.21	4.00
Water activity (a _w)	0.892 ^{ab}	0.890 ^a	0.902 ^b	0.895	0.890	0.902	0.01	1.12
Hardness (N)	17.230 ^b	17.870 ^c	6.432 ^a	13.844	6.432	17.870	6.43	46.45
Adhesiveness (N)	-0.153 ^b	-0.345 ^a	-0.142 ^c	-0.213	-0.345	-0.142	0.11	51.64
Rind thickness (mm)	2.56 ^b	2.72 ^c	2.42 ^a	2.57	2.42	2.72	0.15	5.84
Cross-sectional height of cheese (mm)	34.24 ^b	30.85 ^a	34.91 ^c	33.33	30.85	34.91	2.18	6.54
Cross-sectional area of cheese (cm ² /100g)	9.81 ^c	9.41 ^a	9.50 ^b	9.57	9.41	9.81	0.21	2.19
Density (g/ml)	1.277 ^a	1.317 ^b	1.421 ^c	1.338	1.277	1.421	0.07	5.23

*a-c Different small letters in the columns show statistically significant differences in the values of the tested physical parameters in the goat cheese samples depending on the production day

In the literature there are no a lot of results on physical properties of cheese compared to chemical composition. In this work pH was at normal level for hard cheeses as well as for watter activity. T gi i "cpf "Dncpe" *3; 99+"tgr qtvgf "xcnvgu" for the water activity of different cheeses, from 0.886 and 0.892 for Bergkäse and Parmesan, to 0.995 for Quark. Average values of hardness and adhesiveness for Lider cheese were 13.844 resp. -0.213 N (expressed in g-force 1411.67 resp. -21.72) and were in accordance with values tgr qtvgf "hqt "f khtg gpvV{ r gu"qh'ej gguguOVj wu.'Uctk "gv'cn (2024) established hardness (g) for hard and extra hard, semi-hard, mold ripened and white brined cheeses 2143.43, 1047.56, 1673.40 and 205.17 resp. In the same research, results for adhesiveness (g) were -30.69, -94.57, -540.40, and -26.24 resp. Density was typically high for hard cheeses and in accordance with values obtained for hard and extra hard cheeses (1.276 i lo n"tgr qtvgf "d{ "Uctk "gv'cn (2024). One-factorial analysis of variance revealed that there is a statistically significant influence of the experimental factor (production day) on all examined physical parameters of goat cheese ($p < 0.05$).

Rind thickness, cross-sectional height of cheese and cross-sectional area of cheese are physical parameters of high important in sensory evaluation and control of cheese technology. They give valuable data on cheese ripening conditions (length, humidity and temperature). Maybe more important, all of them, especially, number, shape and size of cheese spores (results not shown in paper but can be visible in Figure 5) play an important role in cheese ripening. Judgement and classification according to spores on cut and therefore their classifying depends on it.



Figure 5. Cut of goat Lيدر cheese after 21 days of ripening

Sensory evaluation showed high quality of Lيدر cheese where cheeses were classified in first class according to total average score. All of them had odour typical for goat milk, pronounced but moderate and pleasant. As shown on the figure 5 spores are equally distributed in cheese body and appropriate shape and size.

Table 3. Sensory evaluation of goat cheese Lيدر

Property	Max.	Production day			Xs	Min.	Max.	St. Dev.	CV (%)
		1	2	3					
External appearance	2	1.82 ^a	1.73 ^a	1.80 ^a	1.78	1.73	1.82	0.05	2.81
Color	1	1.00 ^a	1.00 ^a	1.00 ^a	1.00	1.00	1.00	0.00	0.00
Consistency	2	1.86 ^c	1.62 ^a	1.74 ^b	1.74	1.62	1.86	0.12	6.90
Cut	3	2.54 ^b	2.49 ^{ab}	2.35 ^a	2.46	2.35	2.54	0.10	4.06
Odor	2	1.68 ^a	1.83 ^b	1.94 ^b	1.81	1.68	1.94	0.13	7.18
Taste	10	8.63 ^b	8.35 ^a	8.64 ^b	8.54	8.35	8.64	0.16	1.87
Total	20	17.53 ^b	17.02 ^a	17.48 ^b	17.34	17.02	17.53	0.28	1.61

One-way analysis of variance revealed that there is a statistically significant influence of the sample factor (production day) on all examined sensory parameters of goat cheese except for the evaluation of external appearance and color of goat cheese ($p > 0.05$). This shows the influence of day-by-day variations in applied cheese technology which should be improved.

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I qcV'Nkf gt'ej ggug'ku'r tqf wegf "kp'tgi kqp'qh'b vplekr crk{ 'P kmk . 'O qpvgpi tq. 'htqo 'j ki j" quality goat milk obtained from pasture-fed goats. In terms of FDB, dry matter content and MFFB Lider cheese is a full-fat, hard cheese that is very close to semi-hard cheeses. pH, a_w , hardness and adhesiveness are common for hard and semi-hard types of cheese. According to the overall sensory evaluation, it is classified as high first class. Sensory properties, convenient small dimensions and well-known positive characteristics of goat's milk give it special characteristics and quality.

TGHGTGPEGU'

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TEHNOLOGIJA, FIZIČKO/J GO KLUMG'KUGP\ QTPG'MCTCMVGT KUVKMG" CWVQJ VQPQI 'MQ\ KGI 'UKI'CNKGT"

Sažetak "

W'kutcfllkxcp'lw'uw'kur k'kxcpk'vgj pqrqi klc'K'mxcrk'gv'cwqj vqpqi "nq| kgi "ukt'c'Nkf gt'0'Vq'Ig" tvrdi, punomasni sir koji se proizvodi od pasterizovanog kozijeg mlijeka. Kozije mlijeko se dobiva od koza koje se uzgajaju u brdsko-r'ncpkunqo "r qf tw lw'P kmk c.'Etpc'I qtc'0' Ekl'tcf'c'Ig'f'c'ug'r tgf uvcxk'vgj pqrqi klc'nq| kgi "ukt'c'Nkf gt'nq'k'f'c'ug'kur kclw'hk' nq-hemijske i senzorne karakteristike ovog sira. Ispitani su uzorci sira nakon zrenja od 21 fcp"*tk'ugf'o leg'0'Rtqulg cp'j go klunk'ucvxc"ukt'c'Ig" k'pquk' "i B22i +<'uwj c'o cvgtklc" 83.: 7=0' cu'52.39=r tqv'g'pk'49.7; =uq"5.; 8'k'o nkg pc'nkug'kpc"2.3: 70'Rtqulg cp'ucf'f'cl' masti u suhoj materiji (mast u SM), vode u bezmasnoj materiji sira (VBMS) i soli u vodenoj fazi sira (S/V) iznosio lg'6: .; 6' ."76.64' "k'32.: ; ' 0'Rtqulg cp'r J'lg iznosio 7.47."cmkx'kgv'xqf g"2.: ; 7."f qn'uw' wtf q c'k'rlgr rlxqv'k'pquk'k'13,844N i -0,213N. K'o lgtgpc"lg'r tqulg pc'f gdr'kpc"nqtg'qf"4.79 o o "f qn'uw'r tqulg pc'xkuk'k'r qxt-kpc" r qr tg pqi "r t'gulgn'ukt'c'k'pquk'g"55.55 mm i 9,57 cm²B22i 0'Rtqulg pc'i wuq c'ukt'c'Ig" bila 1,338 i lo r'0'Wmw pc'ugp| qtpc"qelgpc"lg"w'r tqulgnw'k'pquk'k'39.56" -q'qxcl'ukt' svrstava u visoku prvu klasu. Jednofaktorklcpqo "cpcrk'qo "xctklcpug"r >2.27+'wxt gpq" lg'f'c'r quq'k'ucv'uk nk'| pc clcp"wk'cl"r tqk'xqf pqi "f cpc"pc"uxg"hk'k nq-hemijske i senzorne parametre sira osim vanjskog izgleda i boje.

M'lw pg'tklg k<ukt. 'vgj pqrqi klc.'mxcrk'gv'j go klunk'ugp|qt pk'