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Research Article

Yeasts as Ripening Adjunct Cultures in Turkish White Brined Cheese Production

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Abstract: The present study aimed to determine the possibility of using yeasts as adjunct cultures in the production of white brined cheese, which is quite important to the Turkish dairy industry, and to evaluate the effects of these yeasts on cheese ripening. In addition to starter culture (*Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *cremoris*), adjunct yeast cultures of *Yarrowia lipolytica, Debaryomyces hansenii,* and *Kluyveromyces marxianus* were separately co-inoculated to each cheese vat and, therefore, 4 different experimental cheese samples were produced, including the control cheese. Some chemical, microbiological, and sensory properties of the samples were monitored during the 90-day ripening period.

Key Words: Cheese, ripening, adjunct culture, *Debaryomyces hansenii, Yarrowia lipolytica, Kluyveromyces marxianus*

Mayaların Beyaz Peynir Üretiminde Destek Kültür Olarak Kullanımı

Özet: Bu çalışmada ülkemiz süt endüstrisi açısından son derece önemli beyaz peynirin üretiminde bazı mayaların starter kültür olarak kullanım olanaklarının belirlenmesi ve kullanılan mayaların olgunlaşma üzerine etkilerinin tespit edilmesi amaçlanmıştır. Üretimde kullanılan peynir kültürüne (*Lactococcus lactis* subsp. *lactis + Lactococcus lactis* subsp. *cremoris*) ek olarak, peynir teknelerinin her birine ayrı ayrı *Yarrowia lipolytica, Debaryomyces hansenii* ve *Kluyveromyces marxianus* türü mayalar destek kültür olarak aşılanmış ve kontrol örneği de dahil olmak üzere 4 farklı beyaz peynir üretilmiştir. Doksan gün süren olgunlaşma boyunca örneklerin bazı kimyasal, mikrobiyolojik ve duyusal özellikleri belirlenmiştir.

Anahtar Sözcükler: Peynir, olgunlaşma, destek kültür, *Debaryomyces hansenii, Yarrowia lipolytica, Kluyveromyces marxianus*

Introduction

Yeasts are frequently incorporated in the microflora of many different types of cheeses and are thought to make a significant contribution to the ripening process. The occurrence of yeasts in cheese is not unexpected because of their tolerance towards low pH and water activity values, elevated salt concentration, low storage temperatures, and resistance to cleaning compounds and sanitizers (1-4).

The mechanisms by which yeast growth might influence the ripening process are as follows: lipolytic and proteolytic properties, formation of aroma compounds, fermentation of residual lactose, assimilation of such organic acids as lactic acid, and positive interactions with primary starter cultures by excreting such growth factors as B-vitamins (5-8).

Different mixed starter cultures, including thermophilic and/or mesophilic bacteria, are used in the production of Turkish white brined cheese (9). Although the use of probiotic adjunct cultures, or kefir, was previously reported (10-12), there are no data available in the literature about the use of yeasts as adjunct cultures in Turkish white brined cheese production. Thus, the objective of this study was to determine whether the addition of selected yeasts with lactic acid bacteria affects the ripening and/or quality of white brined cheese.

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Materials and Methods

Yarrowia lipolytica NCAIM Y00591, *Debaryomyces hansenii* NCAIM Y01022, and *Kluyveromyces marxianus* NCAIM Y1070 cultures were obtained from the National Collection of Agricultural and Industrial Microorganisms (Budapest, Hungary). Following activation, each freeze-dried concentrated culture was suspended in UHT milk (0.12% fat content), stored at 4-5 °C, and used within 24 h (4). White brined cheese production was carried out in a pilot plant of the Dairy Technology Department of Ege University, İzmir, Turkey. Cheese milk was cooled to 32 °C after pasteurization at 75 °C for 15 s and divided into 4 equal parts (70 l each). Each treatment was inoculated at 0.5% (v/v, 1.16×10^9 cfu/ml) with lactic starter culture of *Lc. lactis* subsp. *lactis* + *Lc. lactis* subsp. *cremoris* (Sacco, Cadorago, CO, Italy) and 0.02% $CaCl_2$ (w/v). Suspended yeasts of *Y. lipolytica* (YL), *D. hansenii* (DH), and *K. marxianus* (KM) in UHT milk were separately inoculated to 3 cheese vats to give a concentration of 10^9 cells/vat (v/v). The last treatment (K) was the control, with only lactic acid bacteria. Cheese samples were ripened in brine (10% NaCl, w/v) at 4 ± 1 °C for 90 days.

Total solids (TS), fat and salt content, and titratable acidity (lactic acid %, LA) of each sample were determined according to Turkish Standard 591 (13). The ripening index (RI) was estimated as [WSN/TN] × 100. The acid degree value (ADV) was determined according to the method described by Renner (14). The pH values were measured with a combined electrode Zeromatic SS-3 pH meter (Beckman Instruments Inc., California, USA).

Free fatty acids (FFAs) were extracted and isolated from cheese according to the AOCS procedure (15). FFA analysis was carried out using an Agilent Technologies model 6890N (Palo Alto, USA) gas chromatograph equipped with a flame ionization detector and an automatic injection unit.

For microbiological analysis, samples (10 g) were emulsified in sterile 2% (w/v) trisodium citrate (Merck KGaA, Darmstadt, Germany) at room temperature using a Colworth Stomacher 400 (Seward Laboratory, UK) and diluted in maximum recovery diluent (Merck KGaA, Darmstadt, Germany). The number of *D. hansenii*, *Y. lipolytica*, and *K. marxianus* colonies was individually counted in YGC agar (Merck KGaA, Darmstadt, Germany) after incubation at 25 °C for 4 days. M17 Agar (Merck KGaA, Darmstadt, Germany) was used for the enumeration of starter culture bacteria and was incubated at 37 °C for 48 h.

Cheese samples were subjected to sensory evaluation by a panel of 6 members familiar with white brined cheese grading. Analysis of variance (ANOVA) was performed using the general linear model procedure in SPSS© v.9.05 (SPSS Inc., Chicago, USA).

Results

Mean values for total solids, fat, salt, titratable acidity (LA), pH, ripening index (RI), and acid degree value (ADV) throughout the ripening of white brined cheese samples are presented in Table 1. According to statistical analysis, all the above-mentioned parameters were significantly affected by the ripening period ($P < 0.05$); however, the chemical composition of the cheeses was not affected by the co-inoculation of adjunct yeast cultures ($P > 0.05$), except for total solid content and titratable acidity ($P < 0.05$).

Total solid content of the different cheese samples, which was initially between 38.77% and 40.56%, decreased during ripening and was between 34.34% and 36.76% at the end of 90 days. Total fat content of the cheese samples was between 18.25% and 23.83%, and decreased gradually during ripening. A marked increase was observed in salt content after the 60th day of ripening in all samples ($P < 0.05$) and the highest salt content was noted in *Y. lipolytica* co-inoculated samples during this period (5.15%-5.19%). Titratable acidity of the samples increased throughout ripening, while pH values decreased ($P < 0.05$). The control (K) samples had the highest LA (1.81%) and lowest pH (4.67) values at the end of ripening. Only the RI values of cheeses that contained *Y. lipolytica* continually increased (0.71%-1.72%), while the RI values of the other cheeses decreased on the 15th day. Nonetheless, those values continued to subsequently increase. The extent of lipolysis expressed as ADV increased continuously during the ripening period for all cheeses ($P < 0.05$); additionally, this increase was striking, especially after the 60th day of ripening.

Free fatty acid composition of all the samples was quite similar (Table 2). Among the saturated fatty acids (SFA), the most abundant was palmitic acid (C16:0), followed by stearic acid (C18:0) and myristic acid (C14:0). Oleic acid (C18:1) content predominated and

Table 1. Changes in chemical composition[a], RI[b], and ADVs[c] of cheeses during ripening (n = 3, ± SD).

Cheese type[d]	Ripening Period (days)	TS (%)	Fat (%)	Salt (%)	LA (%)	pH	RI	ADV
YL	1	40.56 ± 2.7	23.25 ± 0.9	4.52 ± 0.1	0.98 ± 0.1	5.08 ± 0.3	14.62 ± 1.7	0.71 ± 0.1
	15	40.25 ± 2.4	23.08 ± 0.8	4.76 ± 1.1	1.04 ± 0.2	5.08 ± 0.2	18.33 ± 7.0	0.80 ± 0.1
	30	38.54 ± 2.1	21.58 ± 1.6	4.37 ± 1.2	1.11 ± 0.1	5.18 ± 0.2	22.19 ± 1.5	0.98 ± 0.1
	60	38,18 ± 1.1	20.33 ± 1.7	5.15 ± 0.6	1.43 ± 0.3	4.83 ± 0.2	25.31 ± 1.9	1.40 ± 0.1
	90	36.16 ± 2.1	18.25 ± 1.7	5.19 ± 0.6	1.59 ± 0.0	4.82 ± 0.1	29.56 ± 1.7	1.72 ± 0.3
	Mean	38.73 ± 1.7	21.30 ± 2.0	4.79 ± 0.3	1.23 ± 0.2	5.00 ± 0.1	22.00 ± 5.8	1.12 ± 0.4
DH	1	40.17 ± 3.0	23.83 ± 1.3	3.74 ± 0.0	1.14 ± 0.0	5.03 ± 0.3	16.87 ± 2.0	0.70 ± 0.0
	15	39.99 ± 2.5	22.75 ± 2.3	3.90 ± 0.7	1.17 ± 0.2	5.07 ± 0.3	7.52 ± 2.9	0.88 ± 0.1
	30	38.04 ± 2.2	22.75 ± 1.8	3.98 ± 0.9	1.24 ± 0.1	5.08 ± 0.2	24.63 ± 5.8	1.03 ± 0.0
	60	36.78 ± 1.7	19.75 ± 2.0	4.60 ± 0.4	1.53 ± 0.2	4.75 ± 0.2	20.31 ± 2.0	1.62 ± 0.2
	90	36.76 ± 1.0	19.67 ± 0.5	4.72 ± 0.6	1.74 ± 0.1	4.75 ± 0.1	28.47 ± 1.3	1.85 ± 0.4
	Mean	38.35 ± 1.6	21.75 ± 1.9	4.18 ± 0.4	1.36 ± 0.2	4.93 ± 0.1	19.56 ± 8.0	1.21 ± 0.4
KM	1	38.77 ± 1.3	22.75 ± 0.6	3.43 ± 0.2	1.00 ± 0.1	5.00 ± 0.2	17.60 ± 3.5	0.74 ± 0.1
	15	37.11± 2.7	22.08 ± 2.9	4.29 ± 0.8	1.25 ± 0.0	5.12 ± 0.2	10.73 ± 3.8	0.84 ± 0.1
	30	35.97 ± 1.9	21.42 ± 3.1	3.90 ± 1.2	1.29 ± 0.1	5.02 ± 0.2	23.24 ± 4.8	1.08 ± 0.1
	60	35.20 ± 2.7	18.00 ± 2.7	4.68 ± 0.8	1.53 ± 0.2	4.72 ± 0.2	24.08 ± 2.7	1.50 ± 0.2
	90	34.34 ± 2.7	17.75 ± 1.5	5.12 ± 0.4	1.67± 0.1	4.72 ± 0.2	39.84 ± 5.6	1.69 ± 0.2
	Mean	36.27 ± 1.7	20.40 ± 2.3	4.28 ± 0.6	1.34 ± 0.2	4.91 ± 0.1	21.02 ± 1.7	1.17 ± 0.4
C	1	39.27 ± 2.6	22.50 ± 0.5	3.82 ± 0.7	1.24 ± 0.2	4.97 ± 0.3	16.40 ± 4.2	0.70 ± 0.0
	15	37.37 ± 2.8	21.83 ± 1.4	3.90 ± 1.2	1.18 ± 0.1	5.05 ± 0.2	12.12 ± 5.9	0.93 ± 0.1
	30	37.50 ± 0.4	22.08 ± 2.1	3.51 ± 0.7	1.44 ± 0.3	4.97 ± 0.2	18.18 ± 3.0	1.11 ± 0.0
	60	35.11 ± 1.0	18.83 ± 2.3	4.99 ± 0.7	1.51 ± 0.2	4.72 ± 0.1	14.29 ± 8.4	1.47 ± 0.2
	90	36.00 ± 1.1	19.25 ± 1.1	4.80 ± 0.7	1.81 ± 0.0	4.67 ± 0.1	24.94 ± 6.7	1.76 ± 0.4
	Mean	37.05 ± 1.5	20.90 ± 1.7	4.20 ± 0.6	1.43 ± 0.2	4.87 ± 0.1	17.18 ± 4.8	1.19 ± 0.4

[a](g/100 g of cheese), [b](WSN/TN%), [c](meq KOH/100 g of fat).

[d]YL: *Y. lipolytica*-inoculated; DH: *D. hansenii*-inoculated; KM: *K. marxianus*-inoculated;

C: control cheese samples.

Table 2. Mean free fatty acid composition (%) of cheese samples ripened for 90 days (n = 15)[a].

Fatty Acid	YL	DH	KM	C
C4:0	1.75	1.79	1.82	1.78
C6:0	1.40	1.40	1.43	1.42
C8:0	0.97	0.96	0.98	0.97
C10:0	2.34	2.33	2.36	2.35
C11:0	0.24	0.23	0.24	0.24
C12:0	2.88	2.87	2.90	2.89
C13:0	0.06	0.13	0.10	0.06
C14:0	10.70	10.68	10.71	10.71
C14:1	1.04	1.04	1.06	1.06
C15:0	1.14	1.15	1.15	1.15
C15:1	0.36	0.35	0.35	0.35
C16:0	31.79	31.84	31.78	31.79
C16:1	2.08	2.04	2.07	2.04
C17:0	0.59	0.56	0.56	0.56
C17:1	0.40	0.40	0.39	0.40
C18:0	11.89	11.98	11.90	11.92
C18:1 *cis*-9.12	25.78	25.76	25.67	25.72
C18:2 *trans*-9.12	0.52	0.52	0.53	0.53
C18:2 *cis*-9.12	2.60	2.55	2.55	2.59
C18:3 *cis*-6.9.12	0.02	0.05	0.02	0.02
C20:0	0.25	0.25	0.26	0.26
C20:1	0.27	0.26	0.26	0.26
CLA	0.82	0.83	0.82	0.82
SFA[b]	66.05	66.23	66.24	66.17
MUFA[b]	29.95	29.88	29.82	29.84
PUFA[b]	3.98	3.96	3.95	3.98
TUFA[b]	33.94	33.84	33.77	33.82

[a]Three trials with 5 ripening ages.

YL: *Y. lipolytica*-inoculated; DH: *D. hansenii*-inoculated; KM: *K. marxianus*-inoculated; C: control cheese samples.

[b]SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; TUFA: total unsaturated fatty acids.

was the highest among the total unsaturated fatty acids (TUFA). In Table 2 the results for fatty acid proportions in the samples are also categorized as SFA, monounsaturated (MUFA), polyunsaturated (PUFA), and TUFA. These results were not significantly different between the samples.

Changes in the viable counts of yeast adjuncts are presented in Figure 1. In those 3 treatments, yeast adjuncts showed distinctive survival. The number of *Y. lipolytica* gradually decreased and ceased to survive after 60 days of ripening. The number of *D. hansenii* initially increased, then declined between the 15th and 60th days, and increased again until the end of ripening. Among the adjunct yeast cultures, the maximum viable count was observed for *K. marxianus* on the 30th day, but this yeast showed a marked decrease after this period until reaching a value of 1.55×10^4 cfu/g. The co-inoculum of yeasts did not seem to stimulate starter bacteria growth (Figure 2); however, particularly in the early period of ripening, enhanced growth of starter bacteria was noted in *D. hansenii*- or *K. marxianus*-containing cheeses. Furthermore, a significant decrease in starter bacteria counts was observed in all treatments after 60 days ($P < 0.05$), but never decreased to values below 10^7 cfu/g.

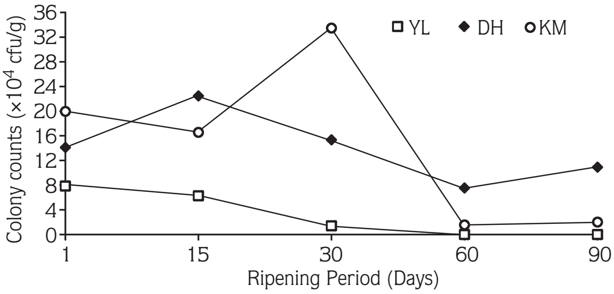

Figure 1. Changes in yeast adjunct counts (n = 3). YL: *Y. lipolytica*-inoculated; DH: *D. hansenii*-inoculated; KM: *K. marxianus*-inoculated cheese samples.

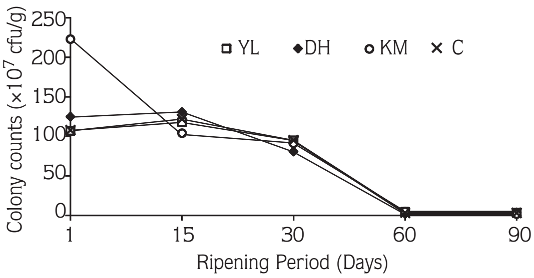

Figure 2. Changes in lactic acid bacteria counts (n = 3). YL: *Y. lipolytica*-inoculated; DH: *D. hansenii*-inoculated; KM: *K. marxianus*-inoculated; C: Control cheese samples.

The results of the sensory evaluation are reported in Table 3. Although the co-inoculation of yeast adjuncts did not affect sensory properties ($P > 0.05$), cheeses containing *Y. lipolytica* were considered more acceptable according to mean scores. Additionally, ripening significantly affected sensory properties of all the samples, which can be clearly seen from the total scores ($P < 0.05$).

Table 3. Sensory evaluation scores of the cheeses (n = 3, ± SD).

Cheese type[a]	Ripening Period (days)	Appearance (20)	Body and Texture (35)	Odor (10)	Taste (35)	Total (100)
YL	1	18.81 ± 1.4	33.10 ± 1.4	9.33 ± 0.3	29.05 ± 6.0	90.29 ± 5.4
	15	17.76 ± 2.5	30.90 ± 1.9	9.62 ± 0.4	29.89 ± 1.8	88.10 ± 2.7
	30	17.67 ± 2.1	21.94 ± 9.2	9.11 ± 0.8	18.41 ± 6.5	67.13 ± 6.7
	60	15.81 ± 3.1	14.31 ± 7.3	8.50 ± 0.4	22.75 ± 6.7	59.35 ± 20.4
	90	15.40 ± 4.0	13.09 ± 7.0	9.59 ± 0.4	20.71 ± 6.0	56.07 ± 17.9
	Mean	17.08 ± 1.4	22.66 ± 9.2	9.23 ± 0.5	24.16 ± 5.1	72.18 ± 16.1
DH	1	16.86 ± 2.2	34.76 ± 0.4	9.19 ± 0.4	30.71 ± 1.2	91.52 ± 1.5
	15	17.71 ± 2.5	26.29 ± 6.0	9.57 ± 0.3	26.02 ± 2.2	79.59 ± 6.3
	30	16.44 ± 1.7	20.56 ± 13.0	9.11 ± 0.8	17.82 ± 5.2	63.93 ± 12.9
	60	14.33 ± 1.7	12.50 ± 2.2	8.61 ± 1.1	19.83 ± 3.5	52.71 ± 5.7
	90	16.64 ± 3.8	16.73 ± 3.6	9.59 ± 0.4	20.82 ± 6.6	61.15 ± 15.7
	Mean	16.39 ± 1.3	22.16 ± 8.7	9.21 ± 0.4	23.04 ± 5.2	69.78 ± 15.6
KM	1	17.76 ± 1.8	30.00 ± 4.3	8.71 ± 0.2	26.43 ± 0.7	82.90 ± 4.5
	15	17.47 ± 2.2	21.06 ± 10.0	9.64 ± 0.3	27.83 ± 3.7	76.01 ± 5.5
	30	17.33 ± 2.3	21.98 ± 12.5	8.56 ± 0.8	19.22 ± 9.5	67.09 ± 21.5
	60	14.59 ± 1.7	15.00 ± 0.8	8.39 ± 0.3	21.83 ± 3.4	57.07 ± 7.7
	90	16.52 ± 3.0	16.28 ± 5.8	9.37 ± 0.7	18.79 ± 2.9	58.09 ± 12.8
	Mean	16.73 ± 1.3	20.86 ± 5.9	8.93 ± 0.5	22.82 ± 4.1	68.23 ± 11.2
C	1	17.29 ± 2.8	32.14 ± 3.7	9.14 ± 0.7	26.19 ± 2.7	84.76 ± 9.1
	15	17.52 ± 2.5	25.54 ± 7.2	9.89 ± 0.2	24.70 ± 2.9	77.65 ± 3.7
	30	16.44 ± 1.7	17.87±12.0	9.24 ± 0.2	13.56 ± 2.9	57.11 ± 12.5
	60	12.81 ± 5.7	10.56 ± 3.9	9.00 ± 0.9	20.47 ± 3.8	50.40 ± 12.5
	90	16.80 ± 2.8	19.18 ± 8.2	9.79 ± 0.2	25.30 ± 3.4	68.17 ± 17.8
	Mean	16.17 ± 1.9	21.05 ± 8.2	9.41 ± 0.4	22.04 ± 5.2	67.61 ± 14.2

[a]YL: *Y. lipolytica*-inoculated; DH: *D. hansenii*-inoculated; KM: *K. marxianus*-inoculated; C: control cheese samples.

Discussion

The chemical composition of all the cheeses was generally within the range typical for white brined cheese. Decreases in total solid content of brined cheeses throughout ripening generally originate from water soluble proteins and peptides passed from the cheese matrix to brine (16). Furthermore, new ionic groups formed by the breakdown of peptides and the elevated water absorbing ability of proteins during cold storage can decrease the total solid content in cheese (17); therefore, changes in fat content could be due to a decrease in total solids. Moreover, increase in salt content during ripening could be attributed the higher water content because salt penetrates the cheese matrix in water.

Yeasts are generally known for their de-acidifying action by utilizing lactic acid with subsequent increases in pH (6); however, changes in pH are not necessarily the result of lactic acid degradation only, but can also be attributed to alkaline products from proteolysis in cheeses co-inoculated with yeasts. During the initial period of ripening, the experimental cheeses maintained a slightly lower lactic acid content and higher pH than the control cheese, especially those in which *Y. lipolytica* was used as co-inoculum (0.98%, pH 5.08) (Table 1). This corresponds with the work by Das et al. (18), who reported higher pH values in 1-day-old cheeses co-inoculated with *Y. lipolytica*. In contrast, Ferreira and Viljoen (4) reported lower pH values than control cheeses in those co-inoculated with *Y. lipolytica* or *D. hansenii*, and attributed the higher lactic acid concentration to increased lactic acid bacterial activity.

Proteolysis in Turkish white brined cheese continues during storage in brine and the ripening index (RI) generally ranges between 3.00% and 25.52 % (9). According to mean RI values, *Y. lipolytica*-containing cheeses had the highest value (22.00%), followed by cheeses co-inoculated with *K. marxianus* (21.02%) and *D. hansenii* (19.56%). This result shows that there was stronger proteinase activity throughout ripening in cheeses co-inoculated with yeasts, because RI renders more information about proteinase activity than peptidase activity. Similar results were obtained by Wyder and Puhan (1), who studied aseptic cheese curd slurries.

In general, the high levels of ADV noted in the experimental cheeses after the 60th day of ripening indicated slow lipolysis. This is in accordance with the findings reported by Gürsoy (12) and Hayaloğlu (16) in white brined cheese, and by Katsiari et al. (19) and Kondyli et al. (20) in Feta cheese. While yeasts, especially *Y. lipolytica*, are known by their strong lipolytic activity, in the present study contrary results was detected. This could be attributed to the observed high salt concentrations, which can affect the lipolytic activity of yeasts (21). Moreover, this result indicates that environmental conditions, such as salt and lactic acid concentrations, as well as temperature can affect the lipolytic and proteolytic activity of *Y. lipolytica* to varying degrees (8,21). In the present study FFA composition of the cheeses was not affected by co-inoculation of yeasts or ripening period. Hayaloğlu et al. (9) reported that according to relative proportions of FFAs, palmitic (C16:0) and stearic acids (C18:0) were the dominant FFAs in Turkish white brined cheese. Our fatty acid composition results (Table 2) are in accordance with Hayaloğlu et al. (9) and Kınık et al. (22).

According to the literature, yeasts grow particularly well during the initial period of ripening (6). Ferreira and Viljoen (4) counted *Y. lipolytica* only during the first half of ripening and observed a decrease in *D. hansenii* during the ripening period to a minimum value of 4.25×10^2 cfu/g after 6 months of maturation. As seen in Figure 1, similar results were obtained in the present study, but only *K. marxianus* reached the highest number on the 30th day of ripening and then declined. In particular, the continuous survival of *D. hansenii* in the cheese samples might be attributed to its greater ability to grow at low temperatures and high salt concentrations (2,3). The high number of lactic acid bacteria was expected in the cheeses co-inoculated with yeast adjuncts (Figure 2); however, only in KM samples were higher levels of lactic acid bacteria initially counted, which can be attributed to the assimilation of lactic acid by *K. marxianus*, which stimulates the growth of starter bacteria.

Perhaps the most important risk factors associated with the use of yeasts as adjunct culture in cheeses are sensory properties. While the biochemical activity of yeast adjuncts can play an important role in the organoleptic features of cheeses due to the production of aromatic compounds and their precursors, such as methyl ketones, alcohols, and esters (4,7), they can negatively affect the sensory properties of cheeses with fruity flavors. The present study found no negative effects on the sensory properties of white brined cheese due to yeast adjuncts.

On the contrary, findings indicate that the presence of the adjunct cultures of *Y. lipolytica* and *D. hansenii* in white brined cheese may have positively influenced sensory properties (Table 3).

It can be concluded that this study provided a new approach to ripening of white brined cheese, which is the most consumed cheese in Turkey. In particular, *Y. lipolytica* and *D. hansenii* are suitable adjunct yeasts cultures. In future studies lower salt concentrations, higher ripening temperatures, and different inoculation amounts can be used, *Y. lipolytica* and *D. hansenii* species, which are naturally present in the microflora of white brined cheese, can be isolated and then used as adjunct cultures, and, finally, yeasts can be inoculated to brine rather than cheese milk.

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