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Effect of Addition of Some Enzymes on The Acceleration of Ras Cheese Manufactured with Addition of Goat's Milk

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THE objective of the present study was to accelerate the ripening of the Egyptian hard cheese (Ras cheese) by addition of goat milk, lipase and protease enzyme.Ras cheese treatments were manufactured as follows, control (C) Ras cheese manufactured from 100% cow milk,T1: Ras cheese manufactured from 80% cow milk and 20% goat milk, T2: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.005% protease enzyme, T3: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.01% protease enzyme,T4: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.02% lipase enzyme, T5: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.04% lipase enzyme. Chemical, sensory and texture profile analysis of the cheese during 90 days of ripening period were evaluated. There was a significant increase in most chemical analysis and a significant decrease in moisture content between all treatments with ripening period progress. For sensory evaluation, total score values showed a significant increase between all treatments with ripening period progress, except for T5 (45 and 90 days) which showed anon significant decrease in total score values especially after 45 days from ripening period, when compared with T1 and T2 (fresh) and a significant decrease when compared with other treatments. The highest values were observed for total score values (T1 90 days), while the lowest values were observed for (T4 fresh) when compared with other treatments.

Keywords: Ras cheese, Protease, Lipase, Goat milk, Texture profile analysis.

Introduction

One of the most popular hard cheeses in Egypt is Ras cheese. It is generally manufactured without the use of special starters from raw cow's milk or a combination of cow and buffalo milk. It is consumed after 3 to 6 months when it has a firm, sharp aroma close to the Greek variant (Kefalotyri cheese). On the other hand, cheese ripening aspects and characteristics are impacted, by milk pasteurisation (Abd-Elmonem et al., 2022). Ras cheese needs some time to age before it can reach its full flavour profile. As a result, a substantial amount of the cost of cheese production is made up of capital expenses for ripening cheese, minimizing the maturation time will decrease the cost of the cheese (El-Hofi et al.,2010). Goat's milk has received a lot of publicity, recently. It is suggested by certain professionals for new-born nutrition and has a better nutritional content than cow's milk. The composition of goat milk is similar to that of cow milk, and the volume of milk fat globule is approximately small,halfof that in cow's milk. Goat milk also has a higher amount of whey proteins. Additionally, it has higher rate of milk allergies and more high disableprotein; also it contains casein micelles that are fewer than those seen in cow milk. Goat's milk takes more time to clot with rennet and forms smoother gels (El-Desoci, 2013).

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Proteases, lipases, esterase's, lactase, and catalase represent the most frequent enzymes found in dairy products, which has a long history of using. Proteases are utilized to promote the maturation of cheese, improve functional characteristics, and induce the modification of milk proteins to minimize the allergic impact of cow's dairy foods for infant. Lipases are utilized to mature cheese and promote the formation of lipolytic aromas. The characteristic cheese aroma is attributed to the degradation of bitter peptides found in matured cheese by peptidases (Budak & Akal, 2018).The production of lipase is widespread and arises from a variety of organisms, including bacteria, mammals, and plants. Only the microbiological sources of lipases are of major commercial interest. Microbial lipases are more economical, simpler to create, more stable and has regulated effect. The kind of fatty acid chain produced during the activity affects taste and flavour. Short-chain fatty acids obviously correlate to the flavour in many matured types of cheese. Short-chain fatty acids (C4-C8) provide a cheesy aroma, while the concentration of long-chain fatty acids should be reduced to remove the soapy flavour profile. In addition to having a direct effect on cheese aroma, lipases accelerate the lipolysis action when it is used alone or in conjunction with a protease. But other cheeses are regarded to be unfavourable for severe lipolysis (Rani & Jagtap,2019). Therefore was amid to accelerate the ripening of the Egyptian hard cheese (Ras cheese) by addition of goat milk, lipase and protease enzyme.

Materials and Methods

Fresh cow's milk (3.4±0.19% fat and 0.18± .11% acidity) was obtained from the herd of the faculty of Agriculture, Cairo University, Sannen goat›s milk (3.1±0.12% fat and 0.17±0.1%) aciditywas obtained from special farm for Sannen goats in Kafr Elzayat region, Egypt.A mixture of cow's and goat›s milk (80:20) 3.2±0.14% fat and 0.18±0.13% acidity as lactic acid) were used to manufacture treatments. Commercial fine grade salt was obtained from the local market. Lactic acid starters (*Lactococcus lactis subsp. lactis* and *Lactobacillus delbruekii subsp bulgaricus*) were obtained from Danisco Company,Egypt. Spain (PROQUIGA) microbial rennet powder (Rhizomucor miehei) was purchased from Caglo star Espana, POL.INDS, ASCOY.Fungi Lipase and protease enzyme were obtained from Chemtic Company, Elmaady, Egypt.Ras cheese treatments were manufactured as follows, C: Ras cheese manufactured from 100% cow milk, T1:Ras cheese manufactured from 80% cow milk and 20% goat milk, T2:Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.005% protease enzyme, T3: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.01% protease enzyme,T4: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.02% lipase enzyme, T5: Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.04% lipase enzyme.The resultant cheeses were salted, then ripened at 14±1°C and 80–85% relative humidity (RH) for three months, during which it was analyzed periodically at 0, 30, 60 and 90 days. Milk and cheese of all treatment were chemically analyzed for moisture, treatable acidity (TA), fat, pH value, salt, total nitrogen (T.N), soluble nitrogen (S.N) and non-protein nitrogen (NPN) contents according to AOAC (2012).The ripening indices, total volatile fatty acids (TVFA) in cheese samples were determined by the method of Kosikowski (1982).

Texture profile analysis (TPA)

Using a Universal Testing Machine (TMS-Pro) from Food Technology Corporation in Sterling, Virginia, USA, equipped with a 1000 N (250 lbf) load cell and linked to a computer running the Texture ProTM texture analysis software, a texture profile analysis test of cheese treatments, whose shape was 2*2*2 cylindricalwas conducted by (program, DEV TPA with holding time between cycle two second). The "cheese treatments" were uniaxial compressed to 30% of their initial height using a flat rod probe (49.95 mm in diameter). Two further cycles (bites) of compression decompression were performed on each sample. Data were gathered on a computer, and the DEV TPA texture analyzer and computer interface were used to estimate the texture profile values. The relevant texture profile characteristics were determined by utilizing the methods stated byBourne (1982) and the International Dairy Federation (Federation, 1991). Hardness, cohesiveness, springiness, gumminess and chewiness were measured at fresh, 45, and 90 days after ripening period.

Sensory evaluation

A panel of 10 tasters of staff and technicians from the dairy science department, Food Technology Research Institute, were selected. The participants graded the cheese in agreement with Foegeding & Drake's (2006) assessment.

Statistical analysis

Data from all experiments were reported using triplicate analysis in the statistical methods. Analysis of variance (ANOVA) and the variance between averages were conducted statistically using the GLM algorithm of SPSS Statistics 22. (SPSS for windows 2013)

Results and Discussion

The Egyptian Standard (2001) stated that the chemical composition of Ras cheese is as follow; DM% and fat/DM% must be not less than 60% and 45%, respectively(Tammam,2007).The chemical composition of Ras cheese treatments are given in Table (1,2).

Fat and fat in dry matter (F/DM) content

There was non-significant difference between T4 and T5 on storage period (90 days), while the high (F) content was observed in T4, T5 for 90 days and T4 for 60 days,with values 37, 36.45 and 36,14%, respectively, whereas there was a significant increase in fat and (F/DM)content for all treatments with the progress of storage period. The increase in fat as a percentage of dry matter can be related to losses in the cheese's solids no-fat contents that occurred as a result of numerous fermentation and breakdown procedures that took place during the ripening period and also linked to the loss in moisture contents(Tammam,2007). The lowest fat content was observed in T1, T2 and T3 (fresh) with values 32.10, 32 and 32.25%, respectively,with anon significant difference. There were non-significant differences in fat content between T5 (60, 90 days), T4 (60days) andcontrol (60, 90days) also, there were non-significant differences in fat content between T3 (90days), T1 (90days), T4 (30days) and control (fresh, 30days) also,the same trend was observed in fat content between T5 (30days), T3 (60days), T1 (60days), T2 (90 days) and control (fresh). The highest value of F.D content was observed in T4 (90days) 57.39%, control (fresh) 57.20%, T4 (30 days) 57.07%, T4 (60 days) 57.04%, with anon significant difference between T4 (90 days), control (fresh), T4 (30, 60 days) and a significant difference with other treatments. The lowest value in F/DM content was observed in T2 (60, 90, 30 days) with values 51.06, 51.12, and 51.14%, respectively, and T5(fresh) with value, 51.84%, with a significant difference with other treatments and anon a significant difference for T2 (90days) .There was non-significant difference in F/DM content, between T5(60days) and T3(30days), also there was non-significant difference between T3 (60 days) and T2 (fresh).The same trend was observed between T1 (90days) andT4 (fresh), whereas there were a significant differences in F/DM contents between control (90, 60, 30 days and fresh), when compared with other treatments. These results were in agreement with those obtained by Guizani et al.(2006),Tammam (2007), Elhofi et al. (2010), El-Desoci (2013), Elfadaly et al.(2015) Rani &Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020) and Abd-Elmonem et al.(2022).

Moisture content

There was a significant decrease in moisture contents between all treatments with storage period progress. According to the literature, the cheese's moisture % reduced over the duration of ripening owing to the evaporation when it was exposed to the maturation conditions (10±2°C and 80-90% relative humidity) for 90 days(Tammam,2007). The highest value of moisture content was observed in control (fresh) 39.46%, T4 (fresh) 39.42% and T2 (fresh) 39.17%, with a significant difference with other treatments. The lowest value in moisture content was observed in T5 (90 days) 32.54%, T5 (60days) 33.23% and T2 (90days) 33.42% with a significant difference with other treatments. There was non-significant difference in moisture content between control (fresh, 30 and 90days) with other treatments, also there was non-significant difference in moisture content between control (60days) and T2 (30days), the same trend also observed between T5 (30days) and T2 (60days). These results were in agreement with those obtained by Guizani et al.(2006), Tammam(2007), Elhofi et al.(2010), El-Desoci(2013), Elfadaly et al.(2015), Rani &Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020) and Abd-Elmonem et al.(2022).

Total solidscontent

There was a significant increase in T.S content between all treatments with storage period progress. The highest value was observed in T5 (90, 60days) with values, 67.46% and 66.77% respectively, and T2 (90days) with a value, 66.50%, with a significant difference with other treatments. The lowest value in T.S content was observed in T2 (fresh) 59.28%, control (fresh) 60.34% and T4 (Fresh) 60.57%, with a significant difference with other treatments. There wasnon-significant difference between control (60 days) and T2 (30 days), also there was non-significant difference between T2 (60 days) and T5 (30days).The same

TABLE 1. Chemical composition of Ras cheese treatments during ripening period

T	Storage period	F	M	T.s	F/D.M	P	T.N
		LSD = 0.67	LSD= 0,11	LSD = 0.058	LSD = 0.044	LSD = 0.028	LSD = 0.099
C	0	34.53±0.03 EF	39.642±0.02 A	60.358±0.04 S	57.20±0.02 B	22.58±0.01 P	3.54±0.02 JKL
	30	35.10±0.1 DE	38.20±0.2 F	61.80±0.01 O	56.79±0.01 D	23.28±0.01 M	3.65±0.05 I
	60	35.50±0.05 CD	36.50±0.1 J	63.50±0.02 K	55.90±0.01 E	24.24±0.04 J	3.80±0.1 GF
	90	36.00±0.1 BC	35.12±0.02 N	64.88±0.01 E	55.48±0.02 F	24.88±0.01 F	3.90±0.01 EDF
T1	0	32.10±0.1 K	38.487±0.02 E	61.513±0.01 P	52.18±0.01 P	22.33±0.03 Q	3.50±0.1 KL
	30	33.00±1.0 IJ	37.50±0.1 G	62.50±0.02 N	52.80±0.1 M	23.54±0.02 L	3.69±0.01 HI
	60	34.10±0.1 FG	36.10±0.1 K	63.90±0.02 I	53.36±0.01 K	23.92±0.02 K	3.75±0.02 HG
	90	35.12±0.02 DE	35.50±0.1 L	64.50±0.05 G	54.49±0.01 H	24.49±0.01 I	3.84±0.02 EGF
T2	0	32.00±1.0 K	39.175±0.02 C	59.825±0.02 T	53.48±0.02 J	22.64±0.01 O	3.55±0.05 JK
	30	32.50±0.03 KJ	36.45±0.01 J	63.55±0.01 K	51.14±0.02 R	23.92±0.02 K	3.75±0.01 HG
	60	33.45±0.05 IH	34.50±0.03 O	65.50±0.02 D	51.06±0.02 S	25.20±0.01 E	3.95±0.01 CD
	90	34.00±0.05 FG	33.42±0.02 P	66.50±0.05 C	51.12±0.02 R	26.09±0.01 B	4.09±0.01 B
T3	0	32.25±0.05 K	38.735±0.03 D	61.27±0.02 Q	52.63±0.03 N	22.58±0.01 P	3.54±0.01 JKL
	30	33.50±0.05IGH	37.10±0.1 H	62.90±0.01 M	53.25±0.03 L	24.56±0.01 H	3.85±0.03 EF
	60	34.15±0.03 FG	36.20±0.02 K	63.80±0.05 J	53.52±0.02 J	26.03±0.03 C	4.10±0.1 B
	90	35.14±0.04 DE	35.60±0.02 L	64.40±0.05 H	54.56±0.01 G	27.05±0.02 A	4.24±0.02 A
T4	0	33.00±1.0 JI	39.43±0.03 B	60.57±0.02 R	54.48±0.01 H	22.01±0.01 R	3.45±0.05 L
	30	35.10±0.1 DE	38.50±0.1 E	61.50±0.1 P	57.07±0.02 C	22.96±0.01 N	3.60±0.2 JI
	60	36.14±0.02 BC	36.65±0.05 I	63.35±0.05 L	57.04±0.03 C	24.56±0.01 H	3.85±0.01 EF
	90	37.00±1.0 A	35.54±0.03 L	64.46±0.01 G	57.39±0.01 A	25.72±0.01 D	4.03±0.03 CB
T5	0	33.50±0.02GHI	35.384±0.01 M	64.626±0.02 F	51.84±0.01 Q	23.28±0.01 M	3.65±0.05 I
	30	34.25±0.05 F	34.54±0.02 O	65.46±0.05 D	52.32±0.02 O	23.92±0.02 K	3.75±0.01 HG
	60	35.55±0.01 CD	33.23±0.03 Q	66.77±0.02 B	53.24±0.02 L	24.81±0.01 G	3.89±0.06 ED
	90	36.45±0.01 AB	32.54±0.02 R	67.46±0.02 A	54.03±0.02 I	26.09±0.01 B	4.09±0.01 B

C - Ras cheese manufactured from 100% cow milk - T1- Ras cheese manufactured from 80% cow milk and 20% goat milk - T2- Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.005 protease enzyme - T3- Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.01 protease enzyme - T4- Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.02 lipase enzyme - T5- Ras cheese manufactured from 80% cow milk and 20% goat milk and treated with 0.04 lipase enzyme . F=fat, TS=Total solids, P=protein, TN= Total Nitrogen

Means with the same letters among treatments and storage period respectively are not significantly different (p> 0.05)

trend was observed between T1 (90days),T4 (90 days), T1 (fresh) and T4 (30days), whereas there wasa significant difference between control (90 days, 60 days, 30 days) and fresh, when compared with other treatments. These results were in agreement with those obtained by Guizani et al.(2006),Tammam(2007), Elhofi et al. (2010), El-Desoci (2013), Elfadaly et al.(2015), Rani &Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020) and Abd-Elmonem et al. (2022)

Protein (P), total nitrogen (T.N) and soluble nitrogen (S.N)content

There was a significant increase in P, T.N and S.N content between all treatments with storage period progress. Peptones, polypeptides, amino acids, and ammonia are all produced as a result of proteolysis during the cheese-ripening action. It can be said that, increases in the total nitrogen values were also due to the loss of moisture that occurred during this time. The degradation of protein is primarily caused by biochemical pathways arising from enzymes and

bacterial actions. Soluble nitrogen determination is a reliable measure of the proteolysis occurring throughout cheese ripening (Tammam,2007). The highest value of P content was observed in T3 (90days) 27.05%, T2 (90 days) 26.09% and T5 (90days) 26.09%, with a significant difference between T3 (90 days) and other treatments, while there was significant difference between T2 (90 days) and T5 (90 days). The lowest value in P content was observed in T4 (fresh) 22.01%, T1 (fresh) 22.33%, control (fresh) 22.58% and T3 (fresh) 22.58%, with anon significant difference between control (fresh) and T1 (fresh),whereas there wasa significant difference for other treatments with each other's. There wasnon-significant difference in P content between T5 (fresh) and control (30 days), also the same trend was observed between T5 (30days), T2 (30 days), T1 (60 days), T3 (30days) and T4 (60 days), while there was significant difference in P content between control (90, 60 and 30 days) and fresh, when compared with other treatments. There were a significant increase in T.N content between all treatments with storage period progress,the highest value of T.N content was observed in T3 (90days) 4.24%, T3 (60 days) 4.10%, T2 (90days) 4.09%, T5 (90days) 4.09% and T4 (90days) 4.03%, with a significant difference for T3 (90days) and a significant difference between each other's and other treatments. The lowest value in T.N content was observed in T4 (fresh) 3.45%, T1 (fresh) 3.50%, control (fresh) 3.54% and T3 (fresh) 3.54%, with anon significant difference between each other's and a significant difference for other treatments. There wasnon-significant difference in T.N content between T5 (fresh), control (30 days), T4 (30 days) and T1 (30 days), also the same trend was observed between control (60 days), T1 (90 days), T4 (60 days) T3 (30 days) and control (90 days) and also between T5 (60 days), T2 (60 days) and control (90 days), while there was significant difference between control (fresh, 30 and 60 days).

There wasa significant increase in S.N content between all treatments with storage period progress. The highest value was observed in T3 (90 days) 0.65%, T2 (90 days) 0.55%, T2(60 days) 0.48% and T1 (90 days) 0.46%, with a significant difference for T3 and T2 (90 days) and anon significant difference between T2 (60 days) and T1 (90 days) which was significantly different with other treatments. The lowest value in S.N content was observed in T3 (fresh) 0.15 %, control (fresh) 0.16%, T4 (fresh) 0.17% and T2 (fresh) 0.17%, with anon significant difference between each other's and also for other treatments. There were non-significant differences in S.N content between T3 (30days) and T4 (30 days), also between T5 (60 days), control (30 days) and T1 (30 days).The same trend was observed between other treatments , while there were significant differences between control (fresh,30, 60 and 90 days) compared with other treatments .These results were in agreement with those obtained by Guizani et al.(2006), Tammam (2007), Elhofi et al.(2010), El-Desoci (2013), Elfadaly et al.(2015), Rani &Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020) and Abd-Elmonem et al. 2022).

Acidity contentand pH

There was a significant increase in acidity content between all treatments with storage period progress.This may be primarily the result of bio-fermentations, (Tammam, 2007). The highest value of acidity content was observed in T3 (90 days) 2.31%, T2 (90 days) 2.10%, T5 (90 days) 2.10% and T5 (60 days) 1.95%, with anon significant difference for T3 (90 days) and a significant difference for other treatments. The lowest value in acidity content was observed in T1 (fresh) 1.54%, control (fresh) 1.55%, T4 (fresh) 1.57%and T2 (fresh) 1.58%, with anon significant difference between each other's and also for other treatments. There was non-significant difference in acidity content between control (fresh and 30 days) and also between control (60 and 90 days) with a significant difference with other treatments. There was non-significant increase in PH value between all treatments until 30 days with storage period progress. The significant increase in PH value was observed after 60 days to 90 days from storage period progress. The utilization of lactic acid, existence of non-acidic products, and liberation of alkaline products as a result of protein breakdown in cheese, as well as the discharge of some alkaline substances of phosphates and soluble substances, are all responsible for the increase in pH values toward the end of ripening (Tammam,2007). The highest value of PH value was observed in control (90 days) 5.59, T3 (90 days) 5.53, T2 (90 days) 5.51 and, T1 (90 days) 5.50, with anon significant difference with each other's and a significant difference for other treatments. The lowest value in PH value was observed in T4, T1, control and T5 (30 days) 4.60,4.60,4.60 and 4.61, respectively and with anon significant difference between each other's and also for other treatments. These results

were in agreement with those obtained by Guizani et al.(2006), Tammam (2007), Elhofi et al.(2010), El-Desoci (2013), Elfadaly et al.(2015), Rani & Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020) and Abd-Elmonem et al.(2022).

Salt content

There was a gradual significant increase in salt content between all treatments with storage period progress especially after 30 days. This may possibly be linked to greater osmosis absorption of the sprinkled salt, which is clearly caused by moisture loss during the ripening stage(Tammam,2007). The highest value of salt content was observed in T5 (90 days) 5.81%, T5 (60 days) 5.3%, control (90 days) 5.22%, T3 (90 days) 5.22% and control (60 days) 5.22, with anon significant difference with each other's and a significant difference for other treatments. The lowest value in salt content was observed in T1, T2, T3, T4 and T5 (fresh) 4.6,4.61,4.61,4.62 and 4.63, respectively, with anon significant difference between each other's and also for other treatments. These results were in agreement with those obtained by Guizani et al.(2006),Tammam (2007), Elhofi et al.(2010), El-Desoci (2013), Elfadaly et al.(2015), Rani &Jagtap (2019), Gomaa et al. (2020), Hamdy et al. (2016), El-Safty et al. (2020), and Abd-Elmonem et al.(2022).

TABLE 2. Chemical composition of Ras cheese treatments during ripening period.

T	Storage period	S.N	Acidity	PH	SALT	TVFA
		LSD = 0.046	LSD = 0.139	LSD = 0.183	LSD = 0.20	LSD = 0.30
C	0	0.16±0.01 ^{N}	1.55±0.05 ^{LK}	4.70±0.1 ^{E}	4.75±0.2 ^{HFGJI}	8.22±0.2 ^{T}
	30	0.25±0.01 ^{KIJ}	1.64±0.01 ^{HJLKI}	4.62±0.1 ^{E}	4.90±0.1 ^{FDE}	10.15±0.1 ^{S}
	60	0.35±0.01 ^{EF}	1.75±0.01 ^{HDGFE}	5.15±0.1 ^{D}	5.15±0.1 ^{CB}	29.98±0.11 ^{M}
	90	0.40±0.1 ^{D}	1.85±0.02 ^{DC}	5.59±0.2 ^{A}	5.26±0.2 ^{B}	40.10±0.1 ^{I}
T1	0	0.19±0.01 ^{NLM}	1.54±0.03 ^{L}	4.69±0.21 E	4.60±0.1 ^{J}	20.25±0.2 ^{R}
	30	0.28±0.01 ^{HIJ}	1.60±0.01 ^{JLKI}	4.61±0.1 E	4.71±0.1 ^{HFGJI}	35.14±0.1 ^{L}
	60	0.37±0.01 ^{ED}	1.70±0.1 ^{HJGFEI}	5.10±0.1 D	4.83±0.1 ^{HFGDEI}	46.20±0.2 ^{H}
	90	0.46±0.02 ^{C}	1.81±0.01 ^{DFE}	5.50±0.1 BA	4.97±0.11^{CDE}	60.12±0.1 ^{C}
T2	0	0.17±0.01 ^{NM}	1.58±0.02 ^{JLK}	4.72±0.1 ^{E}	4.63±0.1 ^{JI}	28.14±0.1 ^{O}
	30	0.30±0.01 ^{HG}	1.67±0.02 ^{HJGLKI}	4.68±0.11 ^{E}	4.76±0.11 ^{HFGJI}	39.15±0.11 ^{J}
	60	0.48±0.01 ^{C}	1.80±0.1 ^{DGFE}	5.09±0.1 ^{D}	4.86±0.11 ^{HFGDE}	55.17±0.1 ^{E}
	90	0.56±0.05 ^{B}	2.12±0.1 ^{B}	5.52±0.11 ^{BA}	4.98±0.11 ^{CD}	60.14±0.1 ^{C}
T3	0	0.15±0.01 ^{N}	1.59±0.01 ^{JLKI}	4.73±0.1 ^{E}	4.68±0.11 ^{HJI}	22.12±0.1 ^{Q}
	30	0.22±0.02 ^{KL}	1.68±0.01 ^{HJGFKI}	4.65±0.1 ^{E}	4.78±0.11 ^{HFGDJEI}	30.15±0.1 ^{M}
	60	0.32±0.02 ^{HGF}	1.85±0.05 ^{DC}	5.11±0.1 ^{D}	4.97±0.11 ^{CDE}	40.15±0.1 ^{I}
	90	0.66±0.05 ^{A}	2.35±0.3 ^{A}	5.55±0.13 ^{A}	5.26±0.2 ^{B}	50.10±0.1 ^{F}
T4	0	0.17±0.01 ^{NM}	1.57±0.01 ^{JLK}	4.75±0.1 ^{E}	4.65±0.1 ^{JI}	25.14±0.1 ^{P}
	30	0.20±0.02 ^{KL}	1.60±0.1 ^{JLKI}	4.60±0.1 ^{E}	4.77±0.11 ^{HFGJEI}	38.16±0.11 ^{K}
	60	0.29±0.01 ^{HI}	1.72±0.02 ^{HDGFE}	5.20±0.1 ^{DC}	4.89±0.11 ^{FGDE}	58.10±0.1 ^{D}
	90	0.34±0.04 ^{EGF}	1.88±0.1 ^{DCE}	5.35±0.05 ^{BC}	5.15±0.1^{CB}	60.14±0.1 ^{C}
T5	0	0.18±0.02 ^{NLM}	1.70±0.01 ^{HJGFEI}	4.76±0.11 ^{E}	4.69±0.11 ^{HGJI}	29.50±0.5 ^{N}
	30	0.21±0.01 ^{KLM}	1.82±0.1 ^{DGFE}	4.63±0.1 ^{E}	4.88±0.11 ^{HFGDE}	48.50±0.5 ^{G}
	60	0.24±0.01 ^{KJ}	1.95±0.02 ^{C}	5.17±0.08 ^{DC}	5.35±0.1 ^{B}	68.98±0.11 ^{B}
	90	0.36±0.02 ^{EDF}	2.10±0.1 ^{B}	5.30±0.05 ^{C}	5.85±0.1 ^{A}	80.25±0.2 ^{A}

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Means with the same letters among treatments and storage period respectively are not significantly different ($p > 0.05$).

Total volatile fatty acids (TVFA)

There was a significant increase in TVFA value between all treatments with storage period progress, the proportion of volatile fatty acids would result from the fermentation of lactose and the hydrolysis of fat (Tammam,2007).The highest value of TVFA value was observed in T5 (90 days) 80.21 and T5 (60 days) 68.92, with a significant difference with each other's and other treatments. The lowest value in TVFA content was observed in control (fresh and 30 days) 8.20 and 10.11, respectively and with a significant difference between each other's and also between other treatments. There were non-significant difference in TVFA content between control (60 days) and T3 (30 days) and also between control (90 days) and T3 (60 days), also the same trend observed between T1, T2 and T4 (90 days), while there was a significant difference between control (60 and 90 days) with other treatments. These results were in agreement with those obtained by Tammam(2007),El-Desoci (2013), Hamdy et al. (2016)and Abd-Elmonem et al.(2022).

Rheological analysis

Table 3 shows the rheological analysis of Ras cheese treatments during ripening period. The obtained results showed that there was a significant increase in flavour value between all treatments with storage period progress. The highest value of flavour value was observed in T1 (90 days), control (90 days), T3 (90 days) and T1 (45 days) with values of 48.8, 47.8, 46 and 46.4, respectively, with anon significant difference with each other's and a significant difference with other treatments. The lowest value in flavour was observed in T2, T3, T4, T5 (fresh) with values of 39.3,39.7, 39.20, 41.2 and 42.3, respectively and with anon significant difference between each other's. However, over ripening of cheeses treated with lipase was always accompanied with the appearance of rancid flavour and solid compact texture especially in (T4 90 days). The degree of rancidity was related to the amount of lipase added and to the length of the ripening period. There was non-significant difference in flavour content between control, T2, T3, T4, T5 (45 days) when compared with T4, T5 (90 days), T1 (fresh) and T2 (90 days). There were a significant increase in body and texture (B.T) values between all treatments with storage period progress, except for T5 (45 and 90 days) which showed anon significant decrease in B.T values especially after 45 days from storage period when compared with T1 and T2 (fresh), and a significant decrease when compared with other treatments.

The highest value were observed in T1 (45 days), control (45 days), control (90 days), T1 (90 days), T3 (90 days) with values of 39.60, 38.60, 38.5, 38.5, and 38.2, respectively, with anon significant difference with each other's. The lowest values in B.T values were observed in T2, T4, T5 (fresh) and T5 (90 days) with anon significant difference between each other's. There were non-significant difference between control (fresh), T1 and T3 (fresh) when compared with T2, T3, T4 (45 days), T2 and T4 (90 days). There was a contrast in appearance values between all treatments with storage period progress. The highest value of appearance was observed in control (fresh), T1 (45 days), control (45 days) and T1 (fresh) with values of 8.5, 8.4, 8.3, and 8.1, respectively, with anon significant difference with each other's. There were non-significant difference in appearance values between T1 (90 days), T3 (45 days) and T1 (fresh). The lowest value in appearance was observed in T5 (90 days), T5 (45 days) and T4 (90 days) with values of 5.4, 6.3 and 6.7, respectively. There were a significant increase in total score values between all treatments with storage period progress, except for T5 (45 and 90 days) which showed anon significant decrease in total score values especially after 45 days from storage period when compared with T1 and T2 (fresh) and a significant decrease when compared with other treatments.

The highest value of total scores values were observed in T1 (45 and 90 days), control (90 days) and control (45 days) with values of 95.1, 94.4, 93.8 and 92.1, respectively, with anon significant difference with each other's. The lowest value in total scores were observed in T2, T4, T5 (fresh) and T5 (90 days) with values of 70.4, 76.9, 79.6 and 81.4, respectively with anon significant difference between each other's and a significant difference was noted for T4 (fresh) only. There was non-significant difference in total score values between T2, T3, T4 (45 days) and also between T3 (45 days) and control (45 days).These results were in agreement with those obtained by Tammam (2007),El-Desoci(2013), Hamdy et al. (2016), Gomaa et al. (2020), El-Safty et al. (2020), El-Sayed et al. (2020) and Abd-Elmonem et al. (2022).

TABLE 3. Rheological analysis of Ras cheese treatmentsduring ripening period

Character assessed	Storage period	C	T1	T2	T3	T4	T5
Flavor	FRESH	45.3±4.3 BDEC	43.6±4.4 FDEC	41.2±4.6 FHG	42.3±4.9 FHEG	39.80±5.8 HG	39.30±4.8 H
Body &texture		36.30±3 BDEC	33.80±3 FGEH	31.30±3 IH	34.10±5 FGE	30.30±7 I	30.80±3 I
Appearance		8.50±1 A	8.10±1 BAC	7.10±0 EF	7.50±1 EDC	6.30±1 G	6.80±1 GF
Total Score		90.1±7.4 BDAC	85.5±6.8 FDEC	79.60±6.9 HI	83.9±8.2 HFEG	70.4±16.1 J	76.9±6.8 I
Flavor	45	45.20±2.9 BDEC	46.40±4.2 BAC	42.7±5.5 FEG	44.4±3.6 FDEC	42.4±5.2 FHEG	43.1±3.3 FDE
Body &texture		38.60±3 BA	39.60±3 A	34.80±2 FGDE	35.90±2 FDEC	34.50±3 FGE	33.50±2 FGH
Appearance		8.30±1 BA	8.40±1 BA	7.30±0 EDF	7.60±1 EDC	7.20±1 EDF	6.30±1 G
Total Score		92.1±2.2 BAC	94.4±5.1 A	84.76±6.8 HFDEC	87.90±3.6 FDEC	84.10±5.4 HFEG	82.90±5.5 HFG
Flavor	90	47.80±0.8 BA	48.8±0.8 A	45.50±0.7 BDEC	46±0.8 BDAC	84.1±1.0 FDEC	43.1±0.7 FDE
Body &texture		38.50±1 BAC	38.50±1 BAC	36.10±1 FBDEC	37.20±1 BDAC	34.10±1 FGE	32.90±1 GIH
Appearance		7.50±1 EDC	7.80±0 BDC	6.80±0 GF	6.70±0 GF	6.70±1 GF	5.40±1 H
Total Score		93.8±1.3 BA	95.1±1.3 A	88.40±1.4 BDEC	89.9±1.4 BDAC	84..2±1.9 HFEG	81.4±1.4 HIG

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Texture Profile analysis

Hardness is described as having a high ability to withstand deformation caused by maximum pressure. Springiness is described as the frequency at which force-damaged food restores its original shape. Gumminess and chewiness are both characterized as types of force needed to degrade a semisolid food into a form that is suitable for swallowing. Cohesiveness is characterized by how likely cheese is to retain together and withstand fracturing into many pieces when compressed (Tunick, 1999; Fox et al., 2000 and Fox et al., 2017). Table 4 shows texture profile analysis of Ras cheese treatments during ripening period.

The obtained results showed that there was a significant increase in hardness values for T1 and control to 45 days from ripening period, then the values were decreased until 90 days from ripening period, with anon significant differences. There was a significant decrease in hardness values for T2, T3 and T4 as ripening period progress to 90 days. There was anon significant increase in hardness values for T5 values as ripening period progress to 90 days. The highest values for hardness values were observed in T5 and the lowest values were observed in T4, with a significant difference with all treatments. There were a significant decrease in adhesiveness values for control and T4 fresh to 90 days from ripening period. There was a significant increase in adhesiveness values for T2 and T3 as ripening period progress to 45 days, and with anon significant difference to 90 days. There was a non-significant decrease in adhesiveness values for T1 and T5 values as ripening period progress to 45 days, and a significant decrease to 90 days. The highest values for adhesiveness values was observed in T4 and the lowest values was observed in T2, with anon significant differences between T1 and T5, and also between T2 and T3, while there was a significant difference with all treatments. Because the hardness was correlated with moisture content, it raised as moisture levels reduced. Cheese proteolysis is responsible for the reduction in hardness at the latter of the storage period. When the amount of enzymes rose, the

hardness values also increased, indicating that lipase-treated cheese became more solid in texture than control cheese. The increase in hardness during the ripening stage may be the result of the reduction in the amount of water phase, which enhances cheese deformation resistance. This might be correlated to the lipolysis mechanism, which reduces the plasticizing action of cheese's fat. A compact texture is produced when fat's plasticizing effect is reduced; this compact texture may be linked to the harder texture.

A compact texture is produced when fat's plasticizing effect is reduced; this compact texture may be correlated to the harder structure (Kanawjia et al., 1995, Johnson et al., 1998 Elsoda, 2014, Hamdy, et al., 2016 and El-Safty, et al., 2020). There were anon significant differences in cohesiveness values for all treatments with ripening period progressed. The highest values for cohesiveness values were observed in T4 and the lowest values were observed in control, with anon significant differences between all treatments.

TABLE 4. Texture profile analysis of Ras cheese treatments during ripening period.

Character assessed	Storage period	C	T1	T2	T3	T4	T5
Hardness (N)	**F**	34.8±0.85 ^{Bd}	33.1±0.40 ^{Ce}	44..05±0.35 ^{Ab}	41.2±0.8 ^{Ac}	23.2±0.85 ^{Af}	89.4±0.1 ^{Ba}
	45	35.65±0.06 ^{Ac}	44.71±0.2 ^{Ab}	35.65±0.05 ^{Bc}	24.7±0.14 ^{Bd}	20.5±0.02 ^{Be}	94.5±0.1 ^{Aa}
	90	31.3±0.08 ^{Cc}	42.3±0.75 ^{Bb}	27.25±0.25 ^{Cd}	17.2±0.75 ^{Ce}	16.1±0.4 ^{Cf}	105±0.8 ^{Ca}
Adhesiveness (mJ)	**F**	0.88±0.08 Ab	0.68±0.01 ^{Ac}	0.280.03 ^{Bd}	0.37±0.04 ^{Bd}	1.380.05 ^{Aa}	0.54±0.02 ^{Ac}
	45	0.74±0.01 ^{B}	0.6±0.02 ^{Ab}	0.59±0.01 ^{Ab}	0.78±0.01 ^{Aa}	0.83±0.03 ^{Ca}	0.48±0.01 ^{Ac}
	90	0.60±0.15 ^{Cc}	0.39±0.04 ^{Bd}	0.6±0.15 ^{Ac}	0.87±0.02 ^{Ab}	1.04±0.1 ^{Ba}	0.42±0.03 ^{Bd}
Cohesiveness (Ratio)	**F**	0.53±0.03 ^{Aa}	0.61±0.01 ^{Aa}	0.63±0.01 ^{Aa}	0.61±0.01 ^{Aa}	0.66±0.01 ^{Aa}	0.63±0.01 ^{Aa}
	45	0.5±0.05 ^{Aa}	0.67±0.02 ^{Aa}	0.68±0.01 ^{Aa}	0.58±0.01 ^{Aa}	0.55±0.05 ^{Aa}	0.62±0.07 ^{Aa}
	90	0.58±0.11 ^{Aa}	0.74±0.05 ^{Aa}	0.73±0.02 ^{Aa}	0.56±0.04 ^{Aa}	0.45±0.05 ^{Aa}	0.67±0.02 ^{Aa}
Springiness (mm)	**F**	8.8±0.4 ^{Ba}	8.8±0.06 ^{Ba}	8.8±0.01 ^{Ca}	8.79±0.03 ^{Ba}	8.8±0.02 ^{Ba}	8.79±0.01 ^{Ba}
	45	9.55±0.51 ^{Ac}	9.19±0.01 ^{Ac}	10.16±0.02 ^{Aa}	9.46±0.5 ^{Ab}	9.49±0.5 ^{Ab}	9.6±0.53 ^{Ac}
	90	8.8±0.2 ^{Bb}	9.19±0.61 ^{Aa}	9.2±0.38 ^{Ba}	8.8±0.49 ^{Bb}	8.6±0.56 ^{Bb}	8.19±0.32 ^{Bb}
Gumminess (N)	**F**	18.44± 0.65 ^{Ae}	20.19±0.45 ^{Cd}	27.75±0.05 ^{Ab}	25.13±0.45 ^{Ac}	15.31±0.15 ^{Af}	56.32±0.8 ^{Ca}
	45	17.82±0.13 ^{Ad}	29.95±0.50 ^{Bb}	24.24±0.1 ^{Bc}	14.32±0.02 ^{Be}	11.27±0.1 ^{Bf}	58.59±0.13 ^{Ba}
	90	18.15±0.09 ^{Ad}	31.3±0.25 ^{Ab}	19.89±0.5 ^{Cc}	9.63±0.4 ^{Ce}	7.24±0.75 ^{Cf}	70.35±0.9 ^{Aa}
Chewiness (mJ)	**F**	162.27±0.13 ^{Be}	177.67±0.61 ^{Bf}	244.2±0.93 ^{Bb}	220.890.99 ^{Ac}	134.72±0.03 ^{Af}	495.05±0.90 ^{Ca}
	45	170.18±·.0.15 ^{Ad}	275.240.±0.60 ^{Cb}	246.27±0.52 ^{Ac}	135.46±0.53 ^{Be}	106.95±0.61 ^{Bf}	562.46±0.53 ^{Ba}
	90	159.72±0.12 ^{Cd}	287.64±0.86 ^{Ab}	182.98±0.99 ^{Cc}	84.74±0.64 ^{Ce}	62.26±0.08 ^{Cf}	576.16±0.11 ^{Aa}

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There was a significant increase in springiness values for all treatments with ripening period progressed to 45 days, and then the values were significantly decreased to 90 days for control, T2, T3, T4 and T5 and with anon significant difference for T1. The highest values for springiness values was observed in control T1, T2 and T4 and the lowest values was observed in T3 and T5, with anon significant differences between all treatments. The reduction in springiness was due to the hydrolysis of para-caseinate molecules, which are responsible for the springiness of cheese curd and depending on various parameters like moisture and cheese fat content (Kanawjia et al., 1995;Johnson et al., 1998; Elsoda, 2014;Hamdy et al., 2016 and El-Safty, et al., 2020). There was anon significant decrease in gumminess values for control to 90 days from ripening period, while there was a significant increase in gumminess values for T1 and T5 as ripening period progress to 90 days. There was a significant decrease in gumminess values for T2, T3 and T4 values as ripening period progress to 90 days.The highest values for gumminess values were observed in T5 and the lowest values were observed in T4, with a significant difference with all treatments.

There was a significant increase in chewiness values for control, T1, T2 and T5 to 45 days from ripening period, then the values were significantly decreased to 90 days for control and T2 and significantly increased to 90 days for T1 and T5. However,there was a significant decrease in chewiness values for T3 and T4 withripening period progress to 90 days. The highest values for chewiness values were observed in T5 and the lowest values were observed in T4, with a significantdifference with all treatments, and with anon significant difference between T1 and T4. These results were in agreement with those obtained by Hamdy et al. (2016), Gomaa et al. (2020), El-Safty et al. (2020) and El-Sayed et al. (2020).Thedecline of gumminess and chewinessvaluesis due to less moisture and higher hardness, harder cheese is more difficult to swallow (Kanawjia et al., 1995; Johnson et al., 1998; Elsoda, 2014; Hamdy et al., 2016 and El-Safty, et al., 2020).

Conclusion

It could be concluded that, experimental fungi lipase (0.02%) and protease enzymes (0.01%) can be used in accelerate the ripening of Ras cheese manufactured from goat milk 20% and cow milk 80% with a typical flavor after 30 to 45 days of ripening period and it was preferred to add enzymes with salting process at the beginning of ripening period to control of Ras cheese quality, validity and economically.

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