Bioprocess Engineering
2021; 5(2): 28-40
http://www.sciencepublishinggroup.com/j/be
doi: 10.11648/j.be.20210502.11
ISSN: 2578-8698 (Print); ISSN: 2578-8701 (Online)

Fortification Effects in Preparation of Fresh Cheese (*Quesoblanco, Gybna beyda & Halloumi*) of Zebu Cow Milk Using Citric Acid Solution, Gambella, Godere Woreda, Ethiopia

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To cite this article:

Dagne Tarle Tarse, Manong Zechariah Rick. Fortification Effects in Preparation of Fresh Cheese (*Quesoblanco, Gybna beyda & Halloumi*) of Zebu Cow Milk Using Citric Acid Solution, Gambella, Godere Woreda, Ethiopia. *Bioprocess Engineering*. Vol. 5, No. 2, 2021, pp. 28-40. doi: 10.11648/j.be.20210502.11

Received: June 13, 2021; **Accepted**: July 19, 2021; **Published**: August 23, 2021

Abstract: Food Technology is on sustainable, priority area with competitive and efficient agri-food production and processing, encompassing and manufacture of safe, value added and innovative foods from milk. The research results revealed that fresh cheese fortification and DMs effects on storage durability, trace-nutrients, anti-nutrients & perception of processed & preserved fresh cheese. The experiment was conducted 3×3×2 in design of treatments expressed as 3 varieties of preserved fresh cheeses like G, H & Q, 3 preservatives (solanum, lemon juice & salt) and 2DMs (sun & oven drying) laid out in CRD. Preserved samples were checked for their safety followed by sensory evaluation & proximate analyses in each month. A total of 4.42 log10 cfu/g AeB was observed in fresh samples with absence of fungi in all varieties of preserved fresh cheeses. MC in freshly preserved was within 23-36% where as high load of 4.0-4.42 log10cfu/g AeB with (P>0.05) significant difference was observed in samples. Initial load of<1.31 log10cfu/g moulds were recorded. After three months of storage, max load of AeB & moulds were 4.83-6.65 and 0-6log10cfu/g, respectively. All parameters under the proximate analyses were vary due to absorption of moisture at ambient condition during the storage time. OA of treated samples reached min & max values of 4.83 and 5.33 after the storage of 3 months respectively. Overall load of 6.65 log10cfu/g AeB in almost all samples was detected and reasonable those samples were not allowed for panelists for taste after the three months storage. This was due to the ISO and EU sensory guidelines showed the point of sensory rejection in which the number of microbial load should be below the 107-108 log10cfu/g. In general, as the storage time of preserved cheese products increased, there were an increased of microbial population and reduction in acceptability of the products through the sample storage of three months. Fresh zebu cow milk was preserved in to new developed products (G, H and Q), lemon fruit juice and salt were used for the indicated preserved products. Anti-nutrient contents such as Hg and aflatoxin were negligible based on international standard requirements. The chemical composition of preserved fresh cheese products contents ranged in MC (23-37%), protein (19.67-40.33%), fat (13.67-32.33), ash (1-8.33%), CHO (10.67-86.67), energy (340.33-454.33kcal), Ca (720-1208g/100mg), Fe (25-41.67g/100g), Zn (4-11.67g/100g) and null contents of Hg were approved based on data analyzed in this research. Eventually, food innovation is a key of any society from local goods is made as an inference of this research work.

Keywords: Fresh Cheese, Product Development, Safety

1. Introduction

Dairy product Processing Technology is on sustainable, priority area with competitive and efficient agri-food production and processing, encompassing and the manufacture of safe, value added milk products and innovative foods from milk to society rather than using whole milk as a single food source [39]. Milk, as an agricultural product, is extracted from mammals during or soon after pregnancy used as food for humans and that can be developed into various cheese products. Traditional cheese making consumes time. Since milk is highly perishable product and Lack of production techniques, manufacturing status and information gap about preparation, fortification effects including engineering properties, chemical composition, micro-nutrients, existence of toxic substances, storage time and microbiological safety of fresh cheese products in communities of Gambella region around Godere woreda are the crucial questions of this investigation. The purpose of this research is to investigate the effect of fortification in preparation of fresh cheese (*Queso blanco, Gybna beyda & Halloumi*) preservation with citric acid/lemon juice and table salt on composition, storage duration, microbial load & sensory acceptability of zebu cow milk. Food or cheese fortification or enrichment is the process of adding micro-nutrients (essential trace elements and vitamins) to food via various food processing and preservation technologies. It may be a purely commercial choice to provide extra-nutrients in to a food with a public health policy which aims to reduce the number of people with dietary deficiencies within a population. Staple foods of a region lack particular nutrients due to different factors or from inherent in adequacy of anormaldiet. Addition of micro-nutrients via preservation to staples and condiments can prevent large-scale deficiency diseases in these cases [39, 40].

2. Fresh Cheese Manufacturing

2.1. Techniques of Cheese Production

The milk that is used for making all cheese products should be of the highest quality, especially with regard to its chemical and microbiological composition, free from any impurities *[82]*.

2.2. Fresh Cheese Processing Procedures

Preparation: Sterilize and sanitize the equipment including all moulds, clothes, spoons, knives & other utensils [99]. This also includes & surfaces used for setting tools down. Acidification and additions: Add starter culture (s) Adding Molds or Smears Diluting and adding Coloring agents CaCl (if needed). Coagulation: Diluting and adding the rennet waiting to cut the curds. Cutting the Curds: Cutting the curd to size and resting the curds Stirring and heating the curds draining the curds from the whey. Making it Cheese: Checking for proper Acidification Cheddaring (if needed) Stretching (if needed) Washing (if needed) Salting (If not brine salted) Putting curds in moulds pressing (if needed). Final Steps for Hard Cheeses: Brining (if needed) Drying (if brined) Aging (if required) [102].

2.2.1. Cheese Preservation (Drying Cheese)

Cheese can be processed in different ways. Most people in the world use high temperature whereas others use the local organic fresh spices for preservation. The major aim of drying cheese is to reduce the moisture content to the lower level while making other nutrients to the safe extent (table 1, moisture content ranges of standard based on kind of product) [82].

Table 1. *Principal range of MC of some common cheese types.*

Very high moisture (80-55%)	High moisture (55-34%)	Medium moisture (45-34%)	Low moisture (34-13%)
Cottage cheese	Mozzarella cheese	Edam cheese	Romano cheese
Ricotta cheese	Camembert cheese	Brick cheese	Parmesan cheese
Cream cheese	Pizza cheese	Swiss cheese	Dry ricotta cheese
	Blue cheese	Cheddar cheese	Gjetost cheese
		Provolone cheese	Mysost cheese

Source: Tararci L. and Kuwkoner E. 2006

2.2.2. Processing of Cheese

The modern manufacture of natural cheese consists of 4 basic steps: coagulating, draining, salting, and ripening. Processing cheese need cleaning, blending, and melting. No two cheese varieties are produced by the same method. Usually, the ranges of manufacturing instructions are indicated as follows [55]: Heating→Separation→Draining→Hanging→Crumbling→Utility (either for consumption or sale at market) [39].

2.2.3. Determination of Cheese Percentage Yield

The yield was determined by a method described by Igyor*et al [57]*. The yield of freshly manufactured cheese from the cow milk-lemon juice blends/mix and the whole cow milk will be determined by the calculation as follows:

$$(X_2/X_1)*100=\text{yield of cheese/Y}(\%) \quad (1)$$

$$X_2/X_1=Y^* \quad (2)$$

Where: X_1=volume (mL) of cow milk-lemon juice or whole cow milk used X_2=weight (g) of cheese (either from blends/whole milk) produced (assume 1gm=1mL).

3. Materials and Methods

3.1. Experimental Design and Treatment

The experiment of this study was laid out in a factorial arrangement of 3x3x2 in a completely randomized design

(CRD) with three replications. These will be three cheese types/varieties (Queso blanco, Hoalloumi and Gibna beyda) with three type of preservatives (solanum dubium juice, lemon juice and salt) and two methods of drying (sun, and oven drying). The controls were fresh, processed and preserved samples of cheesewith no treatment with a total of 12 treatments. The experiment had overall 18 treatments and 18x3x11 (parameters)=594 observations.

Table 2. *Experimental planning.*

Methods	Types of cheese					
	Queso blanco		Halloumi		Gibna Beyda	
	L	Sa	L	Sa	L	Sa
SD	SLQ	SSaQ	SLH	SSaH	SLG	SSaG
OD	OLQ	OSaQ	OLH	OSaH	OLG	OSaG
Control	fresh	Dried	Fresh	Dried	Fresh	Dried

Where: S (sundrying), O (ovendrying), Q (Qusoblanco), H (Hollami), G (Gybena beyeda), L (Lemon juice), and Sa (salt).

3.2. Fresh Cheese Product Development & Evaluation

The methods of three (Queso blanco, Halloumi and G ybna beyda) different fresh cheese preparations were based on ISO2005 of cheese standards.

3.2.1. Data Analyses

Proximate analyses were conducted based on AOAC *[11]* guidelines whereas microbial load was conducted according to Maurine and James *[75]* with the formula indicated below:

$$\text{Formula: } N=\Sigma C/((1*n_1)+(0.1*n_2))*V*(d)$$

C=the sum of colonies on all plates to be counted; n_1=the number of plates to be counted at the 1st dilution; n_2=the number of plates to be counted at the 2nd dilution; v=the volume applied in each plate; d=the dilution from which the 1st count obtained.

3.2.2. Sensory Evaluation

Was conducted using a 7-point hedonic scale and a semi-trained panel consisting of 20 members familiar with the consumption of cheese samples *[1-115]*.

3.2.3. Safety Determination

A total of 18 (treatment) x 3 (triplicate) x 1 (Parameter)=54 samples were prepared from fresh and preserved cheese forAflatoxin M1determination by IAC cleans up followed by HPLC-FLD. Horwitz equation used to calculate relative deviation, i.e. RSD_R=2 [(1−0.5 logC)] or PRSDR (%)=2C–0.15; Where: RSD_R=the relative standard deviation calculated from results generated under reproducibility conditions [(Sr/X')x100]. C=the concentration ratio (i.e. 1=100g/100g, 0.001=1000mg/kg). Approximately 1 kg of each type of sample was homogenized in a food blender (Warning) before analyses *[53-74]*.

3.2.4. Statistical Analyses

Results Analyses of variance was performed by one-way ANOVA procedures with statistical software (version SAS9.1) and means were evaluated at the $P<0.05$ level of significanceusing fisher's LSD and Duncan's new multiple range test [45].

4. Result and Discussion

4.1. Data Interpretation of Fresh Cheese Product Development

Fresh products manufacturing from raw materials were revealed as:

(a) safety

Table 3. *APC and moulds in fresh cheese preparation.*

	Type of microbial load (log10cfu/g)	
Experimental samples	**Aerobic plate count (APC)**	**Total mould count**
Quso blanko (Q)	4.00±0.01a	ND
Gybena byeda (G	4.07±0.01a	ND
Holami (H)	4.42±0.01a	ND

Where, LSD=least significant difference=Varieties, G=geybenabyeda, H=holami,&the values are mean±SD in that the mean values followed by the same letterin a column are not significantly different at 5% level of significance.

Based on results stated in table, very few APC with no significant difference and absence of moulds (ND) in all the three varieties of fresh cheese samples were reported. Thus indicate that the way of data collection, sample processing & source of fresh milk were very safe *[11]*.

Table 4. *APC of preserved cheese samples stored for 60days.*

V	Aerobic plate count (log10cfu/g)			
	Storage period (days)			
	0	20th	40th	60th
G	4.83±.41a	5.00±0.00a	6.00±0.00a	6.63±.085a
H	5.00±0.00a	5.00±0.00a	6.00±0.00a	6.61±.11a
Q	4.83±.401a	5.00±0.00a	6.00±0.00a	6.65±.06a
LSD	0.043	0.00	0.00	0.55

Where, LSD=least significant difference=Varieties=g eybena byeda, H=holami, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

Significant differences (P>0.05) were not observed between all the three varieties (G, H and Q) in all the treated and untreated preserved fresh cheese storage of 60 days. However, the higher load of APC was reported in H type samples at 0 day storage while in reverse lower result of APC was been seen after 60 days storage against of the other two varieties of cheese samples with statistically no significant difference s indicated that the preservatives (salt, lemon fruit and solanum dubium juice) and application of heat during processing had inhibitory effects on growth of microorganisms of the preservation of fresh cheese. However, at the point of sensory rejection, the APC in products could typically be 10^7-10^8cfu/g [36, 75].

Table 5. *The load of total moulds on dried cheese storage.*

V	Aerobic plate count (log10cfu/g)			
	Storage period (days)			
	0	**20th**	**40th**	**60th**
G	0.00±.00[a]	3.00±0.00[a]	4.00±0.00[a]	6.00±.00[a]
H	0.00±0.00[a]	2.83±0.41[a]	4.00±0.00[a]	6.00±.00[a]
Q	0.00±.00[a]	3.00±0.00[a]	4.00±0.00[a]	6.00±.00[a]
LSD	0.00	0.26	0.00	0.00

Where, LSD=least significant difference, V=Varieties, G=geybena byeda, H=holami, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

They were steady increased load of moulds from zero or null (ND) of the 0 day storage to the 60 days storage time of thepreserved fresh cheese products. No significant differences (P>0.05) were observed between all the three varieties (G, H and Q) of fresh cheese samples during the storage of three months.

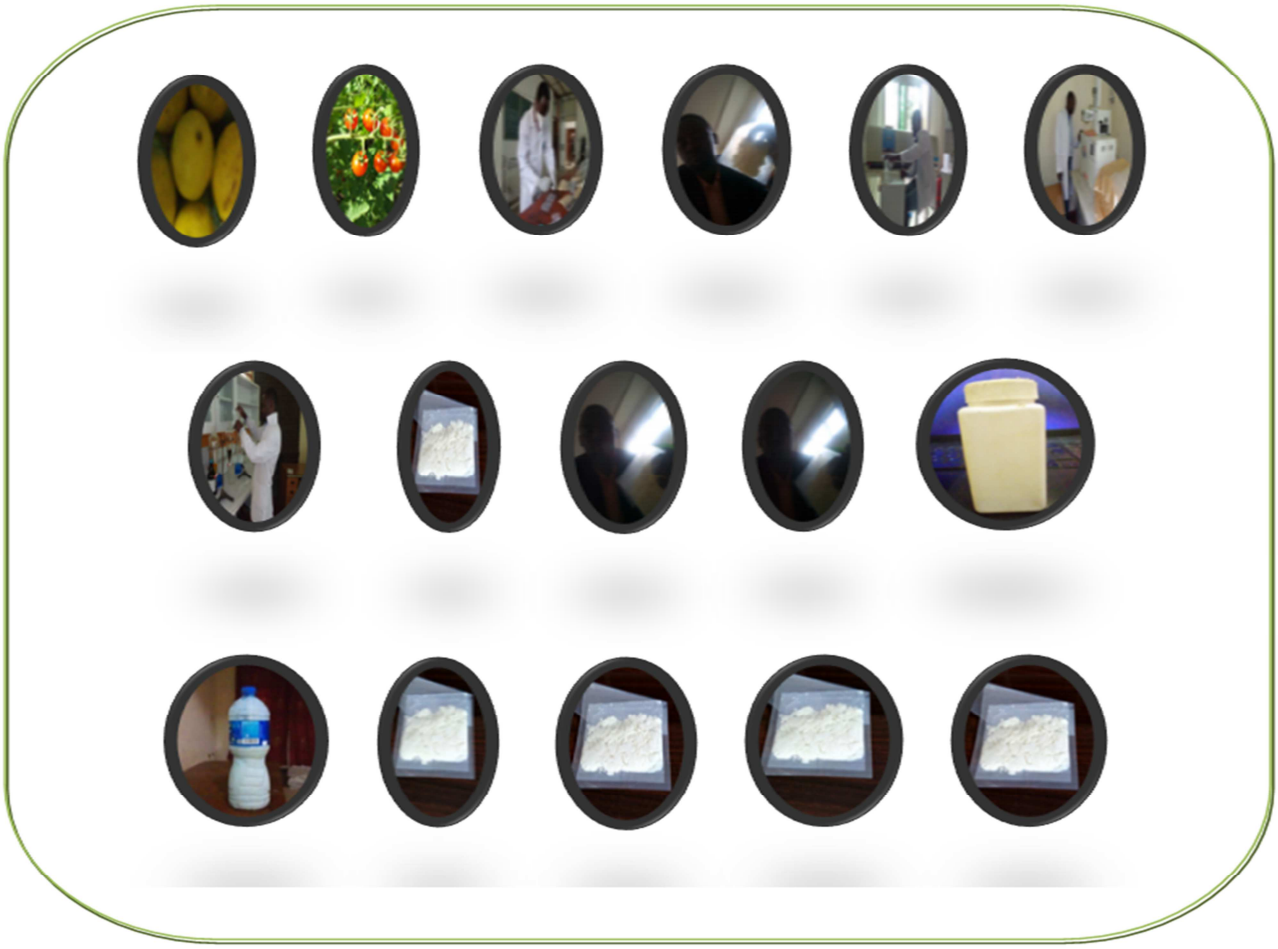

Figure 1. *Fresh cheese manufacturing.*

(b) Acceptability of Samples by Panelists

Table 6. *Acceptability of Fresh and Dried Samples before Storage.*

DM	Trt	V	Color	Odor	Taste	Texture	OA
	DG	G	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
D	DH	H	7.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	DQ	Q	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	6.00±00^{a}
	FG	G	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	7.00±00^{a}	6.00±00^{a}
F	FH	H	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	7.00±00^{a}
	FQ	Q	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	OLG	LG	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
OD	OLH	LH	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	7.00±00^{a}	7.00±00^{a}
	OLQ	LQ	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	5.00±00^{a}	7.00±00^{a}
	ONG	G	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}
	ONH	H	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
	SLG	LG	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	5.00±00^{a}	5.00±00^{a}
SD	SLH	LH	7.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
	SLQ	LQ	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	SNG	NG	5.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	5.00±00^{a}
	SNH	NH	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	SNQ	NQ	5.50±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}

Table 7. *Effect of treatment combination on sensory score after storage of 1month.*

DM	Trt	V	Color	Odor	Taste	Texture	OA
	DG	G	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
D	DH	H	7.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	DQ	Q	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	7.00±00^{a}	6.00±00^{a}
	FG	G	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	6.00±00^{a}
F	FH	H	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	7.00±00^{a}
	FQ	Q	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	OLG	LG	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
OD	OLH	LH	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	7.00±00^{a}	7.00±00^{a}
	OLQ	LQ	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	7.00±00^{a}
	ONG	G	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}
	ONH	H	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
	SLG	LG	6.00±00^{a}	6.00±00^{a}	7.00±00^{a}	5.00±00^{a}	5.00±00^{a}
SD	SLH	LH	7.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}
	SLQ	LQ	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	SNG	NG	5.00±00^{a}	6.00±00^{a}	6.00±00^{a}	5.00±00^{a}	5.00±00^{a}
	SNH	NH	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}
	SNQ	NQ	5.50±00^{a}	6.50±00^{a}	6.00±00^{a}	6.00±00^{a}	6.00±00^{a}

Table 8. *Sensory acceptability test results of dried cheeses after the storage of 2 months.*

V	Color	Odor	Taste	Texture	OA
G	5.83±.41^{a}	11.83±15.78^{a}	5.67±.82^{ab}	5.17±.75^{a}	5.50±.55^{a}
H	5.50±.84^{a}	5.83±.41^{b}	6.00±.00^{a}	5.33±1.37^{a}	5.33±1.21^{a}
Q	5.83±.41^{a}	4.50±1.38^{c}	4.67±1.51^{b}	4.67±1.37^{a}	5.17±1.33^{a}
LSD	0.37	0.21	0.10	0.38	0.62

Table 9. *Sensory Acceptability of Dried cheese after Storage of 3 Months.*

V	Color	Odor	Taste	Texture	OA
G	5.00±1.27^{a}	5.17±.98^{a}	5.33±1.03^{a}	4.50±1.23^{ab}	5.00±.63^{a}
H	5.67±.52^{a}	5.50±.84^{a}	5.50±.84^{a}	5.00±.89^{a}	4.83±.98^{ab}
Q	4.50±1.38^{ab}	4.67±1.51^{ab}	5.50±.84^{a}	5.50±.84^{a}	5.33±.82^{a}

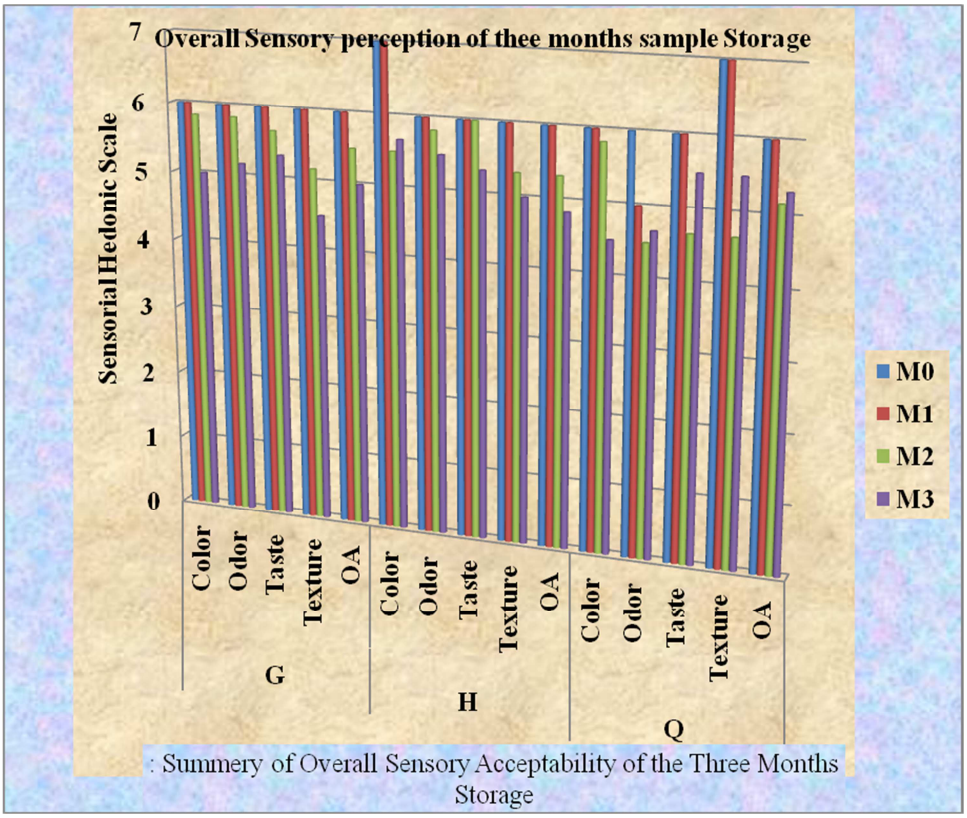

Figure 2. *Sensory evaluation pattern of the three months storage.*

(c) Proximate analysis and ant-nutritional contents of preserved fresh cheese

Table 10. *Proximate analysis freshly processed cheese varieties.*

V	MC (%)	Ash (%)	Prot (%)	Fat (%)	Fiber (%)	CHO (%)	Energy (cal)	Vit-C (100g)	Ca (100g)	Fe (100g)	Zn (100g)
G	30.45±3.24^{a}	.88±.04^{a}	33.07±6.17^{a}	18.83±3.19^{b}	.014±.02^{a}	16.75±2.23^{a}	368.80±14.64^{b}	.07±.00^{a}	854.45±97.13^{a}	37.74±2.18^{a}	8.90±2.72^{a}
H	27.17±1.94^{b}	2.02±2.84^{a}	26.76±5.88^{a}	28.17±5.74^{a}	.01±.00^{a}	15.87±5.22^{a}	424.04±43.78^{a}	.05±.03^{a}	809.38±66.66^{ab}	36.05±2.52^{a}	8.60±3.05^{a}
Q	27.60±1.96^{ab}	2.03±2.38^{a}	31.96±4.02^{a}	20.33±5.20^{b}	.02±.02^{a}	18.06±2.54^{a}	383.10±31.10^{b}	.07±.00^{a}	758.38±42.33^{b}	33.35±5.82^{a}	8.74±2.84^{a}

Where, LSD=least significant difference=varieties, vit-C=vitamin C, G=geybena beyeda, H=holami, Q=queso blanko, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

Table 11. *Standard Requirement of Some Parameters in Processed & Preserved Cheese.*

United states standard	Year	Test Method	Standard Level
Hg in Enriched Cheese	2011	AOAC 1999.10	1PPM (Max Permitted)
Vitamin-C	2006	-	<2g/day
Moisture content	2000	-	50-86%
Ca	-	200g	138 (mg)
Zn	-	AOAC 1999.10	50PPM (Max Permitted)
Fe	-	AOAC 1999.10	0.5PPM (Max Permitted)

Yield of cheese was obtained using the equation (%)=X2/X1 x 100; Where: X1=volume (mL) of cow milk-lemon juice or whole cow milk used X2=weight (g) of cheese (either from blends/whole milk) produced (assume 1 gm=1 mL).

Crude protein was calculated as: % crude protein=% N2 x conversion factor whereas % of moisture content was calculated from:

$$\%\ Moisture\ content = \frac{W2 - W3}{W2 - W1} x\ 100$$

The % of ash content was calculated as:

$$\%\ Ash\ content = \frac{W3 - W1}{W2 - W1} x\ 100$$

Moreover, to calculate fat content, weighe d (w1) was round bottom flask and extracted oil were cooled and then weighed (w2). Using the equation:

$$\%\ Crude\ fat\ content = \frac{W2 - W1 =}{Weight\ of\ sample} x\ 100$$

Crude fibre determined as the weighed sample (C1) and reweighed (C2) after heating. Then loss in weight of sample on in cineration=C1 – C2. So, using the equation:

$$\%\ Crude\ fibre = \frac{C1 - C2}{Weight\ of\ original\ sample} x\ 100$$

Total carbohydrate content was determined according AOAC 2000 using the equation: Total carbohydrate=100 - (% moisture + % Ash + % fat + % protein + % fibre). Moreover, the rest parameters were analyzed based standard establishments according to ISO international requirement procedures working actively in laboratories whereas estimated number of colonies per gram of sample was calculated for APC & Moulds calculated using formula indicated below:

Formula: $N=\Sigma C/((1*n_1)+(0.1*n_2))*V*(d)$

Obtained data was analyzed using SPSS 16.0 and presented results on various tables under the chapter 4 of results and discussion soft his research of the fresh cheese products.

Table 12. *Proximate analyses of fresh & preserved fresh cheese after storage of1month.*

Treatment	MC (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	CHO (%)
D	2.83E+01±2.89E+00^{bc}	1.00E+00±0.00E+00^{d}	3.27E+01±2.89E+00^{def}	2.13E+01±1.16E+00de	0.00E+00±0.00E+00^{b}	1.67E+01±1.16E+00^{b}
DG	3.03E+01±5.77E-01^{b}	1.00E+00±0.00E+00^{d}	2.63E+01±5.77E-01^{h}	2.30E+01±1.73E+00^{d}	0.00E+00±0.00E+00^{b}	2.20E+01±1.73E+00^{b}
DH	2.87E+01±2.31E+00^{bc}	8.33E+00±5.77E-01^{a}	2.03E+01±5.77E-01^{i}	1.90E+01±1.73E+00^{ef}	0.00E+00±0.00E+00^{b}	2.37E+01±2.31E+00^{b}
DQ	2.27E+01±2.08E+00^{e}	1.00E+00±0.00E+00^{d}	3.63E+01±2.52E+00^{bc}	1.50E+01±2.00E+00^{h}	0.00E+00±0.00E+00^{b}	1.80E+01±0.00E+00^{b}
FG	2.33E+01±2.89E+00de	1.00E+00±0.00E+00^{d}	3.47E+01±1.16E+00^{bcd}	2.90E+01±1.73E+00^{b}	0.00E+00±0.00E+00^{b}	1.13E+01±1.16E+00^{b}
FH	2.80E+01±1.73E+00^{bc}	1.00E+00±0.00E+00^{d}	3.00E+01±1.73E+00^{fg}	2.93E+01±5.77E-01^{b}	0.00E+00±0.00E+00^{b}	1.37E+01±5.77E-01^{b}
FQ	2.50E+01±3.61E+00^{cde}	7.00E+00±0.00E+00^{b}	2.77E+01±2.52E+00^{gh}	1.37E+01±2.31E+00^{h}	0.00E+00±0.00E+00^{b}	2.40E+01±3.61E+00^{b}
OLG	3.67E+01±5.77E-01^{a}	1.00E+00±0.00E+00^{d}	2.63E+01±5.77E-01^{h}	2.20E+01±1.73E+00^{d}	0.00E+00±0.00E+00^{b}	1.40E+01±1.73E+00^{b}
OLH	2.87E+01±1.16E+00^{bc}	1.00E+00±0.00E+00^{d}	2.13E+01±2.31E+00^{i}	3.13E+01±1.16E+00^{ab}	0.00E+00±0.00E+00^{b}	2.00E+01±1.73E+00^{b}
OLQ	2.73E+01±1.16E+00^{bc}	1.00E+00±0.00E+00^{d}	3.37E+01±1.16E+00^{cde}	1.83E+01±1.16E+00^{f}	6.70E-01±1.16E+00^{a}	1.90E+01±0.00E+00^{b}
ONG	3.00E+01±1.73E+00^{b}	1.00E+00±0.00E+00^{d}	3.70E+01±1.73E+00^{b}	1.63E+01±1.16E+00^{fgh}	0.00E+00±0.00E+00^{b}	1.57E+01±1.16E+00^{b}
ONH	2.77E+01±1.16E+00^{bc}	1.00E+00±0.00E+00^{d}	3.07E+01±5.77E-01^{efg}	2.63E+01±5.77E-01^{c}	0.00E+00±0.00E+00^{b}	1.33E+01±2.89E+00^{b}
SLG	2.87E+01±1.16E+00^{bc}	1.00E+00±0.00E+00^{d}	3.73E+01±1.16E+00^{ab}	1.53E+01±1.16E+00^{gh}	0.00E+00±0.00E+00^{b}	1.77E+01±1.16E+00^{b}
SLH	2.33E+01±2.89E+00de	1.00E+00±0.00E+00^{d}	2.93E+01±5.77E-01^{gh}	3.13E+01±5.77E-01^{ab}	0.00E+00±0.00E+00^{b}	1.50E+01±1.73E+00^{b}
SLQ	2.70E+01±4.00E+00^{bcd}	2.00E+00±0.00E+00^{cd}	3.30E+01±4.00E+00^{def}	1.80E+01±2.00E+00^{fg}	0.00E+00±0.00E+00^{b}	8.67E+01±1.17E+02^{a}
SNG	2.77E+01±2.31E+00^{bc}	1.00E+00±0.00E+00^{d}	4.03E+01±2.31E+00^{a}	1.47E+01±5.77E-01^{h}	0.00E+00±0.00E+00^{b}	1.63E+01±5.77E-01^{b}
SNH	2.87E+01±1.16E+00^{bc}	1.00E+00±0.00E+00^{d}	2.63E+01±1.16E+00^{h}	3.27E+01±2.31E+00^{a}	0.00E+00±0.00E+00^{b}	1.07E+01±1.16E+00^{b}
SNQ	3.07E+01±5.77E-01^{b}	2.33E+00±2.31E+00^{c}	2.83E+01±5.77E-01^{gh}	2.27E+01±2.31E+00^{d}	0.00E+00±0.00E+00^{b}	1.47E+01±2.31E+00^{b}
LSD	0.62	0.077	0.054	0.55	1.00	0.621

Treatment	Energy (cal)	Vit-C (100g)	Ca (100g)	Fe (100g)	Zn (100g)	Hg (100g)
D	3.88E+02±2.31E+00^{g}	0.00E+00±0.00E+00^{a}	1.05E+03±2.31E+00^{h}	3.33E+01±2.89E+00^{fg}	7.33E+00±2.31E+00^{b}	0.00E+00±0.00E+00^{a}
DG	3.87E+02±0.00E+00^{g}	0.00E+00±0.00E+00^{a}	8.13E+02±3.46E+00^{l}	3.50E+01±3.46E+00^{defg}	5.00E+00±0.00E+00^{cd}	0.00E+00±0.00E+00^{a}
DH	3.40E+02±2.31E+00^{k}	0.00E+00±0.00E+00^{a}	7.76E+02±5.20E+00^{n}	3.60E+01±5.20E+00^{bcdefg}	6.00E+00±0.00E+00^{bc}	0.00E+00±0.00E+00^{a}
DQ	3.86E+02±6.35E+00^{g}	0.00E+00±0.00E+00^{a}	1.00E+03±5.77E+00^{j}	2.50E+01±0.00E+00^{i}	1.00E+01±0.00E+00^{a}	0.00E+00±0.00E+00^{a}
FG	4.38E+02±1.16E+00^{c}	0.00E+00±0.00E+00^{a}	1.07E+03±2.89E+00^{f}	3.43E+01±2.89E+00^{efg}	4.00E+00±0.00E+00^{d}	0.00E+00±0.00E+00^{a}
FH	4.33E+02±1.73E+00^{d}	0.00E+00±0.00E+00^{a}	7.99E+02±1.73E+00^{m}	3.93E+01±1.16E+00^{abc}	1.17E+01±1.16E+00^{a}	0.00E+00±0.00E+00^{a}
FQ	3.39E+02±2.52E+00^{k}	0.00E+00±0.00E+00^{a}	7.21E+02±2.31E+00^{o}	2.87E+01±1.16E+00^{h}	5.00E+00±0.00E+00^{cd}	0.00E+00±0.00E+00^{a}
OLG	3.56E+02±2.89E+00^{j}	0.00E+00±0.00E+00^{a}	1.21E+03±2.89E+00^{a}	3.73E+01±1.16E+00^{bcdef}	1.17E+01±1.16E+00^{a}	0.00E+00±0.00E+00^{a}
OLH	4.45E+02±1.73E+00^{b}	0.00E+00±0.00E+00^{a}	1.20E+03±1.16E+00^{b}	3.87E+01±1.16E+00^{abcd}	1.10E+01±0.00E+00^{a}	0.00E+00±0.00E+00^{a}
OLQ	3.77E+02±4.04E+00^{h}	0.00E+00±0.00E+00^{a}	1.17E+03±4.04E+00^{c}	3.30E+01±1.73E+00^{g}	1.10E+01±1.73E+00^{a}	0.00E+00±0.00E+00^{a}
ONG	3.66E+02±2.31E+00^{i}	0.00E+00±0.00E+00^{a}	1.02E+03±2.31E+00^{i}	3.83E+01±5.77E-01^{abcde}	1.07E+01±5.77E-01^{a}	0.00E+00±0.00E+00^{a}
ONH	4.20E+02±2.89E+00^{e}	0.00E+00±0.00E+00^{a}	1.10E+03±1.16E+00^{e}	3.97E+01±1.16E+00^{ab}	1.00E+01±0.00E+00^{a}	0.00E+00±0.00E+00^{a}
SLG	3.65E+02±2.31E+00^{i}	0.00E+00±0.00E+00^{a}	1.01E+03±2.31E+00^{j}	3.57E+01±5.77E-01^{bcdefg}	1.13E+01±5.77E-01^{a}	0.00E+00±0.00E+00^{a}
SLH	4.51E+02±5.77E-01^{a}	0.00E+00±0.00E+00^{a}	9.59E+02±5.77E-01^{k}	3.63E+01±1.16E+00^{bcdefg}	1.17E+01±1.16E+00^{a}	0.00E+00±0.00E+00^{a}
SLQ	3.75E+02±2.00E+00^{h}	0.00E+00±0.00E+00^{a}	1.21E+03±2.00E+00^{a}	3.80E+01±2.00E+00^{abcde}	1.10E+01±2.00E+00^{a}	0.00E+00±0.00E+00^{a}
SNG	3.57E+02±2.31E+00^{j}	0.00E+00±0.00E+00^{a}	1.07E+03±2.31E+00^{g}	4.17E+01±5.77E-01^{a}	1.03E+01±5.77E-01^{a}	0.00E+00±0.00E+00^{a}
SNH	4.54E+02±1.16E+00^{a}	0.00E+00±0.00E+00^{a}	1.10E+03±4.04E+00^{d}	3.53E+01±2.31E+00^{cdefg}	1.10E+01±1.73E+00^{a}	0.00E+00±0.00E+00^{a}
SNQ	3.93E+02±2.31E+00^{f}	0.00E+00±0.00E+00^{a}	9.57E+02±1.73E+00^{k}	3.60E+01±1.73E+00^{bcdefg}	5.00E+00±0.00E+00^{cd}	0.00E+00±0.00E+00^{a}
LSD	0.097	0.00	0.35	0.53	0.12	0.00

Where, LSD=least significant difference, D=dried fresh cheese, DG=dried gyebena byeda, DH=dried holami, DQ=dried queso blanko, FG=fresh geyebena bayeda, FH=fresh holami, FQ=fresh queso blanko, OL=oven dried lemon treated, ON=oven dried not treated, SL=sun dried lemon treated, SN=sun dried not treated, Vit-C=vitamine C, G=geybena beyeda, H=holami, Q=queso blanko, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

Table 13. *Proximate analyses of fresh & preserved fresh cheese after the storage of 2 month.*

Treatment	MC (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	CHO (%)
DG	28.67±1.16^{bc}	1.00±.00^{c}	37.33±1.16^{abc}	15.33±1.16^{hij}	.00±.00^{a}	17.67±1.16^{b}
DH	23.33±2.89^{e}	1.00±.00^{c}	29.33±.58^{fg}	31.33±.58^{ab}	.00±.00^{a}	15.00±1.73^{b}
DQ	24.00±1.73^{de}	1.00±.00^{c}	38.00±1.73^{ab}	15.67±2.31^{hij}	.00±.00^{a}	18.00±.00^{b}
FG	30.33±.58^{b}	1.00±.00^{c}	26.33±.58^{g}	23.00±1.73^{de}	.00±.00^{a}	22.00±1.73^{b}
FH	28.67±2.31^{bc}	8.33±.58^{a}	20.33±.58^{h}	19.00±1.73^{fgh}	.00±.00^{a}	23.67±2.31^{b}
FQ	25.00±3.61^{cde}	7.00±.00^{b}	27.67±2.52^{fg}	13.67±2.31^{j}	.00±.00^{a}	21.67±1.16^{b}
OLG	27.67±2.31^{bcd}	1.00±.00^{c}	40.33±2.31^{a}	14.67±.58^{ij}	.00±.00^{a}	16.33±.58^{b}
OLH	28.67±1.16^{bc}	1.00±.00^{c}	26.33±1.16^{g}	32.67±2.31^{a}	.00±.00^{a}	10.67±1.16^{b}
OLQ	28.00±.00^{bc}	1.00±.00^{c}	33.00±.00de	19.00±.00^{fgh}	.00±.00^{a}	19.00±.00^{b}
ONG	28.33±2.89^{bc}	1.00±.00^{c}	32.67±2.89^{de}	21.33±1.16^{efg}	.00±.00^{a}	16.67±1.16^{b}
ONH	23.33±2.89^{e}	1.00±.00^{c}	34.67±1.16^{cd}	29.00±1.73^{bc}	.00±.00^{a}	11.33±1.16^{b}
SLG	36.67±.58^{a}	1.00±.00^{c}	26.33±.577^{g}	22.00±1.73^{ef}	.00±.00^{a}	14.00±1.73^{b}
SLH	28.67±1.16^{bc}	1.00±.00^{c}	21.33±2.31^{h}	31.33±1.16^{ab}	.00±.00^{a}	20.00±1.73^{b}
SLQ	27.00±4.00^{bcde}	2.00±.00^{c}	33.00±4.00^{de}	18.00±2.00^{ghi}	.00±.00^{a}	86.67±117.21^{a}
SNG	30.00±1.73^{b}	1.00±.00^{c}	37.00±1.73^{bc}	16.33±1.16^{hij}	.00±.00^{a}	15.67±1.16^{b}
SNH	27.67±1.16^{bcd}	1.00±.00^{c}	30.67±.58^{ef}	26.33±.58^{cd}	.00±.00^{a}	13.33±2.89^{b}
SNQ	29.33±1.86^{b}	1.67±1.63^{c}	29.17±1.47^{fg}	26.00±3.95^{cd}	.00±.00^{a}	14.17±1.60^{b}
LSD	0.64	0.621	0.053	0.056	0.00	0.621

Treatment	Energy (cal)	Vit-C (100g)	Ca (100g)	Fe (100g)	Zn (100g)	Hg (100g)
DG	365.33±2.31^{ef}	.00±.00^{a}	1005.67±2.31^{de}	35.67±.58^{bcdef}	11.33±.577^{ab}	.00±.00^{a}
DH	450.67±.58^{ab}	.00±.00^{a}	959.33±.58^{e}	36.33±1.16^{bcdef}	11.67±1.16^{a}	.00±.00^{a}
DQ	382.00±.00^{d}	.00±.00^{a}	1003.33±5.78^{de}	25.00±.00^{g}	10.00±.00^{abc}	.00±.00^{a}
FG	387.00±.00^{d}	.00±.00^{a}	813.00±3.46^{g}	35.00±3.46^{cdef}	5.00±.00^{ef}	.00±.00^{a}
FH	340.33±2.31^{g}	.00±.00^{a}	776.00±5.20^{g}	36.00±5.20^{bcdef}	6.00±.00^{def}	.00±.00^{a}
FQ	338.67±2.89^{g}	.00±.00^{a}	720.00±.00^{h}	28.00±.00^{g}	5.00±.00^{ef}	.00±.00^{a}
OLG	357.33±2.31^{f}	.00±.00^{a}	1066.67±2.31^{bc}	41.67±.58^{a}	10.33±.58^{abc}	.00±.00^{a}
OLH	454.33±1.16^{a}	.00±.00^{a}	1104.67±4.04^{b}	35.33±2.31^{cdef}	11.00±1.73^{ab}	.00±.00^{a}
OLQ	379.00±.00de	.00±.00^{a}	1167.00±.00^{a}	34.00±.00^{ef}	10.00±.00^{abc}	.00±.00^{a}
ONG	388.33±2.31^{d}	.00±.00^{a}	1048.67±2.31^{bcd}	33.33±2.89^{f}	7.33±2.31^{cde}	.00±.00^{a}
ONH	437.67±1.16^{b}	.00±.00^{a}	1072.67±2.89^{bc}	34.33±2.89^{def}	4.00±.00^{f}	.00±.00^{a}
SLG	355.67±2.89^{f}	.00±.00^{a}	1206.33±2.89^{a}	37.33±1.16^{bcdef}	11.67±1.16^{a}	.00±.00^{a}
SLH	445.00±1.73^{ab}	.00±.00^{a}	1199.33±1.16^{a}	38.67±1.16^{abc}	11.00±.00^{ab}	.00±.00^{a}
SLQ	375.00±2.00^{de}	.00±.00^{a}	1208.00±2.00^{a}	38.00±2.00^{abcde}	11.00±2.00^{ab}	.00±.00^{a}
SNG	366.33±2.31^{ef}	.00±.00^{a}	1022.67±2.31^{cd}	38.33±.58^{abcd}	10.67±.58^{ab}	.00±.00^{a}
SNH	419.67±2.89^{c}	.00±.00^{a}	1099.33±1.16^{b}	39.67±1.16^{ab}	10.00±.00^{abc}	.00±.00^{a}
SNQ	413.17±21.80^{c}	.00±.00^{a}	878.00±86.55^{f}	37.67±2.25^{bcde}	8.33±3.72^{bcd}	.00±.00^{a}
LSD	0.065	0.00	0.057	0.052	0.053	0.00

Where, LSD=least significant difference, D=dried fresh cheese, DG=dried gyebena byeda, DH=dried holami, DQ=dried queso blanko, FG=fresh geyebena bayeda, FH=fresh holami, FQ=fresh queso blanko, OL=oven dried lemon treated, ON=oven dried not treated, SL=sun dried lemon treated, SN=sun dried not treated, Vit-C=vitamine C, G=geybena beyeda, H=holami, Q=queso blank, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

Table 14. *Proximate analyses of fresh and preserved fresh cheese after the storage of 3 month.*

Treatment	MC (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	CHO (%)
D	32.00±2.65^{b}	2.33±2.31^{c}	27.67±1.53^{gh}	22.00±2.00^{e}		14.67±2.31^{b}
DG	29.00±1.00^{bcd}	1.00±.00^{d}	37.33±1.16^{ab}	15.00±1.00^{k}	.00±.00^{a}	17.67±1.16^{b}
DH	24.33±4.04^{d}	1.00±.00^{d}	29.00±1.00^{fgh}	31.00±1.00^{abc}	.00±.00^{a}	14.67±2.08^{b}
DQ	25.00±3.00^{cd}	1.00±.00^{d}	37.67±1.53^{ab}	15.33±2.08^{jk}	.00±.00^{a}	17.67±.58^{b}
FG	30.33±.58^{bc}	1.00±.00^{d}	26.33±.58^{h}	22.67±2.08^{e}	.00±.00^{a}	21.67±2.08^{b}
FH	29.33±3.06^{bcd}	8.33±.58^{a}	19.67±1.53^{i}	19.00±1.73^{fgh}	.00±.00^{a}	23.67±2.31^{b}
FQ	26.67±6.03^{bcd}	7.00±.00^{b}	26.67±1.53^{h}	13.00±2.00^{k}	.00±.00^{a}	21.67±1.16^{b}
OLG	28.33±3.06^{bcd}	1.00±.00^{d}	40.00±2.65^{a}	14.33±.58^{k}	.00±.00^{a}	16.33±.58^{b}
OLH	29.00±1.00^{bcd}	1.00±.00^{d}	26.33±1.16^{h}	32.33±2.08^{a}	.00±.00^{a}	10.67±1.16^{b}
OLQ	29.00±1.73^{bcd}	1.00±.00^{d}	32.67±.58^{cde}	18.67±.58^{ghi}	.00±.00^{a}	19.00±.00^{b}
ONG	28.33±2.89^{bcd}	1.00±.00^{d}	33.33±2.52^{cd}	21.00±1.00^{efg}	.00±.00^{a}	16.33±1.53^{b}
ONH	24.33±4.04^{d}	1.00±.00^{d}	34.67±1.16^{bc}	28.33±2.52^{cd}	.00±.00^{a}	11.00±1.00^{b}
SLG	37.00±1.00^{a}	1.00±.00^{d}	26.00±1.00^{h}	21.67±2.08^{ef}	.00±.00^{a}	13.67±1.53^{b}
SLH	29.33±1.16^{bcd}	1.00±.00^{d}	21.33±2.31^{i}	32.00±2.00^{ab}	.00±.00^{a}	20.00±1.73^{b}
SLQ	28.00±4.36^{bcd}	2.00±.00^{cd}	32.00±4.36^{cdef}	18.00±2.00^{hij}	.00±.00^{a}	86.67±117.21^{a}
SNG	30.33±1.53^{bc}	1.00±.00^{d}	37.00±1.73^{ab}	16.00±1.00^{ijk}	.00±.00^{a}	15.67±1.16^{b}
SNH	28.00±1.00^{bcd}	1.00±.00^{d}	30.67±.58^{defg}	25.67±1.53^{d}	.00±.00^{a}	13.33±2.89^{b}
SNQ	28.67±1.53^{bcd}	1.00±.00^{d}	29.33±2.52^{efgh}	29.33±.58^{bc}	.00±.00^{a}	13.67±.58^{b}
LSD	0.061	0.077	0.052	0.055	0.00	14.67±2.31^{b}

Treatment	Energy (cal)	Vit-C (100g)	Ca (100g)	Fe (100g)	Zn (100g)	Hg (100g)
D	393.33±2.31^{g}		957.00±1.73^{k}	36.00±1.73^{bcdefg}	5.00±.00^{cd}	
DG	365.33±2.31^{l}	.00±.00^{a}	1005.67±2.31^{j}	35.67±.58^{cdefg}	11.33±.58^{a}	.00±.00^{a}
DH	450.67±.58^{b}	.00±.00^{a}	959.33±.58^{k}	36.33±1.16^{bcdefg}	11.67±1.16^{a}	.00±.00^{a}
DQ	382.00±.00^{i}	.00±.00^{a}	1003.33±5.77^{j}	25.00±.00^{h}	10.00±.00^{a}	.00±.00^{a}
FG	387.00±.00^{h}	.00±.00^{a}	813.00±3.46^{l}	35.00±3.46^{defg}	5.00±.00^{cd}	.00±.00^{a}
FH	340.33±2.31^{n}	.00±.00^{a}	776.00±5.20^{n}	36.00±5.20^{bcdefg}	6.00±.00^{bc}	.00±.00^{a}
FQ	338.67±2.89^{n}	.00±.00^{a}	720.00±.00^{o}	28.00±.00^{h}	5.00±.00^{cd}	.00±.00^{a}
OLG	357.00±2.65^{m}	.00±.00^{a}	1066.67±2.31^{g}	41.67±.58^{a}	10.33±.58^{a}	.00±.00^{a}
OLH	454.33±1.16^{a}	.00±.00^{a}	1104.67±4.04^{d}	35.33±2.31^{defg}	11.00±1.73^{a}	.00±.00^{a}
OLQ	378.67±.58^{j}	.00±.00^{a}	1167.00±.00^{c}	34.00±.00^{fg}	10.00±.00^{a}	.00±.00^{a}
ONG	388.33±2.31^{h}	.00±.00^{a}	1048.67±2.31^{h}	33.33±2.89^{g}	7.33±2.31^{b}	.00±.00^{a}
ONH	437.67±1.16^{d}	.00±.00^{a}	1072.67±2.89^{f}	34.33±2.89^{efg}	4.00±.00^{d}	.00±.00^{a}
SLG	355.67±2.89^{m}	.00±.00^{a}	1206.33±2.89^{a}	37.33±1.16^{bcdef}	11.67±1.16^{a}	.00±.00^{a}
SLH	445.00±1.73^{c}	.00±.00^{a}	1199.33±1.16^{b}	38.67±1.16^{abcd}	11.00±.00^{a}	.00±.00^{a}
SLQ	375.00±2.00^{k}	.00±.00^{a}	1208.00±2.00^{a}	38.00±2.00^{abcde}	11.00±2.00^{a}	.00±.00^{a}
SNG	366.33±2.31^{l}	.00±.00^{a}	1022.67±2.31^{i}	38.33±.58^{abcd}	10.67±.58^{a}	.00±.00^{a}
SNH	419.67±2.89^{f}	.00±.00^{a}	1099.33±1.16^{e}	39.67±1.16^{ab}	10.00±.00^{a}	.00±.00^{a}
SNQ	433.00±1.73^{e}	.00±.00^{a}	799.00±1.73^{m}	39.33±1.16^{abc}	11.67±1.16^{a}	.00±.00^{a}
LSD	0.42	0.00	0.312	0.06	0.088	0.00

Where, LSD=least significant difference, D=dried fresh cheese, DG=dried gyebena byeda, DH=dried holami, DQ=dried queso blanko, FG=fresh geyebena bayeda, FH=fresh holami, FQ=fresh queso blanko, OL=oven dried lemon treated, ON=oven dried not treated, SL=sun dried lemon treated, SN=sundried not treated, Vit-C=vitamine C, G=geybena beyeda, H=holami, Q=queso blank, and the values are mean ± SD in that the mean values followed by the same letter in a column are not significantly different at 5% level of significance.

4.2. Ethical Clearance

Preserved cheese products were checked for Aflatoxin M1 and the heavy element named mercury per 100g sample. These anti-nutrients were negligible based on international standard guidelines for the ethical assurance as new products provision for customers or consumers in similar to the results reported by Emire Admassu Shimelis and Sudip Kumar Rakshit, [52] and Yaroglu, T. *et a*l [111].

5. Conclusion and Recommendation

The study was conducted to assess fresh cheese fortification effects of DMs and processing effects on storage durability, trace-nutrients, anti-nutrients and consumption acceptability of processed and preserved fresh cheese. The research was conducted 3×3×2 in design of treatments expressed as varieties of preserved fresh cheeses like G, H and Q, 3 preservatives (solanum dubium juice, lemon juice and salt) and 2DMs (sun and oven drying) in its experimental planning. Preserved cheese samples were allowed for proximate analysis, Vitamin-C, content of anti-nutrients, customer perception, safety and product quality controls. Preserved stored samples were tested for nutritional content and safety, consumer acceptability per month and reported during the storage of the three months. A total of 4.42log$_{10}$cfu/g AeB was detected while mould counts were reported as ND at the beginning stage before storage in all the experimental samples of preserved cheeses. The MC in freshly preserved samples was within 23–36% whereas high load of 4.0-4.42 log$_{10}$cfu/g AeB was revealed with significant ($P>0.05$) difference in all the sample varieties. A total of <1.31 log$_{10}$cfu/g load of moulds was registered initially before storage. Maximum load of 4.83-6.65 log$_{10}$cfu/g AeB and 0-6 log$_{10}$cfu/g moulds were detected after the storage of three months. Vitamin-C & load of anti-nutritional contents in samples were observed in their appreciable levels. All the parameters under the proximate analysis were varying due to absorption of moisture at ambient condition during the storage time. Overall acceptability of treated samples reached minimum and maximum values of 4.83 (neither like nor dislike) and 5.33 (like slightly) respectively after the storage of 3 months. Total load of 6.65 log$_{10}$cfu/g AeB almost in all samples was detected after the storage of three months. Hence, after the storage of three months, samples were not allowed for panelists to taste based on the compliance of the ethical clearance. Based on the product safety guidelines, the load of microbial in this research was under the 10^{7}-10^{8} log$_{10}$cfu/g [36]. The ISO 2006 standard specifications was referred in which point of sensory rejection can be attained if microbial load exceeds 10^{7}-10^{8} log$_{10}$cfu/g in sample and overall load of microorganism should be below the 10^{7}-10^{8} log$_{10}$cfu/g [36]. In general, as the storage time of preserved cheese products increased, there were an increased of microbial population & reduction in acceptability of the products through the sample storage of three months [7, 14, 22, 36, 39, 52, 55, 57, 58, 63, 88, 99, 102].

5.1. Conclusion

The findings revealed that the three varieties of preserved fresh cheese contain appreciable amounts of nutrients that the body requires for its normal metabolic functions. The hot spices and plant products enzymatic analogies should be applied for preservation purpose to develop new products to the community in activate microbial load and lengthen shelf-life of preserved fresh cheese. The fresh zebu cow milk was preserved in to the new developed products (G, H and Q) using locally available raw materials like solanum dubium juice, lemon fruit juice and salt were used for the indicated

preserved products. The anti-nutrient contents such as Hg and aflatoxin weren egligible based on international standard requirements. The chemical composition of preserved fresh cheese products contents ranged in MC (23-37%), protein (19.67-40.33%), fat (13.67-32.33), ash (1-8.33%), CHO (10.67-86.67), energy (340.33-454.33kcal), Ca (720-1208g/100mg), Fe (25-41.67g/100g), Zn (4-11.67g/100g) and null contents of Hg were approved based on data analyzed in this research [112, 1-115]. Cheese product development and safety is scientific food innovation disciple and research area where scholars manufacture varies products as a key of any society from local goods is made as an inference of this research work [1-3, 5-7, 14, 22, 36, 39, 52, 55, 57, 58, 63, 88, 99, 102, 112].

5.2. Recommendations

Recommendations were pointed by the authors based on results of this study: the following recommendations are made in order to improve the quality of preserved fresh cheese product development: Improved fresh milk, freshly preserved cheese handling, processing and preservation must be promoted. Additionally, intensive research and technology transfer of optimization of animal products fortification, treatment prior and during the preservation technologies in fresh milk, cheese and product, development, processing and preservations hould be encouraged. Any more anti-nutrients associated with product development should be investigated. Researches also needed to investigate the effect of different types of packaging materials and storage durations on microbial quality and shelf-life of preserved fresh cheese products for its long storage. More in depth research that will allow a longer period of storage can be explored in advancement with a view to standardize ing the spices as well as establishing the exact ‘Shelf-life’ of the product [1-115].

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