Evaluation of selected spices and herb extracts on oxidative stability, microbial and sensory quality of fermented cow milk butter.

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Abstract

Butter is the product made by churning of fermented milk. This study was conducted with the objective of evaluation of seed extract of Fenugreek (*Trigonella foenum-graecum*), Korarima *(Aframomum korarima*) and leaf extract of Koseret (*Lippiaadoensis var. koseret* on oxidative stability, microbial and sensory quality of Cow milk butter. After butter produced, it was treated with Fenugreek, Korarima and Koseret at 0.2%, compared with 0.02% of butylated hydroxyl tolune and control butter. Physicochemical and microbial changes occurring during storage period of butter were analyzed every 7 days for a month. The sensory quality of butter was evaluated using 25 untrained panelists based on 7 points hedonic scale. The results of analyses suggest that addition of Koseret herb was more effective in retardation of oxidation, lowering microbial load and has better sensory acceptance than other samples. In conclusion, Koseret incorporated butter has comparable efficiency with 0.02% butylated hydroxyl tolune.

Keywords: Butter, Microbial load, Oxidative stability, Sensory acceptability

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Introduction

In Ethiopia 98% of the milk is produced by smallholder farmers and pastoralists. From this, the majority of milk (around 40%) produced in rural areas of Ethiopia is processed into butter through traditional fermentation [1]. Butter is the most widely consumed milk product in Ethiopia with an attractive appearance, white to light yellowish colour, pleasant taste and odour when fresh, as storage increases butter deterioration occur in physicochemical, microbial and sensory quality of butter if not, preserved [2]. Animal butter is highly consumed by the people of Ethiopia and has been mostly used in rural areas of Ethiopia due to resource accessibility over other fatty foods. However, the production of butter is still carried out following traditional processes, which rely on a spontaneous fermentation without addition of any treatments thus limiting its commercialization [3]. The deterioration of butter in particular and fat in general appeared generates off flavours which accompanied with the formation of peroxides. Peroxides limit shelf life of dairy products and could be responsible for an undesirable rancid flavor. The process of fat oxidation can be prevented by adding antioxidant substances [4]. Antioxidant is substance that inhibits oxidation of the substrate. They terminate chain reactions by scavenging free radical intermediates and by inhibiting other oxidation reactions [5]. The aim of this study was to extend the oxidative stability of butter through the use of natural antioxidant sources as a means of preservatives.

Materials and Methods

This research was carried out in the laboratory of School of Nutrition, Food Science and Technology of hawassa University.

Preparation of butter

Butter was prepared from raw milk purchased from local farmers. The pasteurized milk was fermented traditionally by placing it at room temperature. Churning was done when the pH of the milk reached 4.13. Butter was made by churning the fermented milk sample by churner (CLAIR, Germany) [6]. At the end of the churning process, the Butter grains were skimmed off, kneaded in cold water and washed to remove visible residual of buttermilk [7].

Extraction and preparation of sample

Butter prepared with spices and herb was done according to Flavia Pop and Delia Boltea. About 1000 g of butter samples weighed in duplicate pyrex beakers and were divided into five treatment groups was mixed with 0.4 ml extracts were added to 200 g and were vortexed (VM-300, Taiwan) for a minute. About 0.04 ml BHT added on 200 g of butter was used as

reference and sample without the extract as a control. Finally, butter samples were analyzed for physicochemical, oxidative stability and microbial quality.

Physicochemical Characteristics of Butter

Determination of moisture and fat

The moisture content of butter samples were conducted according to Richard D. and O'Brien.

Determination of pH, titratable acidity, free fatty acid value and peroxide value

The pH, titratable acidity, Free fatty acid value and peroxide value was determined according to (AOAC) in 2000.

Thiobarbituric Acid Reactive Substances (TBARS) assay

The TBARS assay based on the detection of a stable product, which is formed between malondialdehyde and Thio Barbituric Acid (TBA) in the aqueous phase, was conducted according to Bakchiche et al. [8].

Microbiological Analysis of Butter

Total aerobic mesophilic plate count and Total mold and yeast count

The analysis of butter samples were done according to NMKL (2006).

Total enterobacteriaceae count

Enterobacteriaceae count of butter was performed according to NMKL (2005).

Sensory evaluation of butter

Sensory evaluation of butter samples were conducted according to the method desired by Abdel Moneim, et al. using 7 points Hedonic scale by 25 untrained consumer oriented panellists [9].

Data analysis

The data generated from experiment were analysed using Analysis of Variance (One way ANOVA) statistical system software (SAS, version 9). The data on microbial counts were first transformed to logarithmic (log10) values before subjected to statistical analysis. $P<0.05$ was considered as the level of significance using Duncan multiple ranges test.

Results and Discussion

Physicochemical characteristics of preservative added butter

Moisture content: High moisture content in fats and oils usually leads to increase in microbial load as well as lipid oxidation resulting in rancidity. From the results of Table 1, the Moisture content among butter samples treated with Fenugreek, Korarima, Koseret and BHT decrease during storage time [10]. Table 4 shows changes in moisture contents of butter samples. Initially, moisture content of control butter was found to be 23% on zero weeks and decreased to 15 ± 1.4% on the 4th week. This might be due to the evaporation of moisture from the butter during storage. The moisture contents of butter samples included with Koseret was 23% on the zero week and 11% on the 4th week decrease faster than other butter samples. This might be due to the difference in composition of spices. The change in moisture content might be due to the change in fat level of butter samples. This result is supported with the result of that showed the moisture content of butter treated with different spices and control butter decreases throughout the storage time. In contrast, Nadeem et al. reported that the addition of different amount of *Moringa olefera* did not have any negative effect on compositional attributes of butter moisture content of all the treatments [11].

Fat: Fat content of butter incorporated with Fenugreek, Korarima and Koseret are shown in Table 1. The fat contents in butter samples increase during the storage of 28 days. This might be due to decrease in the moisture content of butter samples [12]. The maximum fat contents of butter samples were recorded by butter incorporated with Koseret 73% on the zero week and 87% on the 4th week with respect to other extract treated butter samples. The maximum fat content of Koseret butter samples was because of thickening properties of preservatives [13]. The control butter sample has fat content of 73% to 83.5% from zero to 4th week of storage time. These slow increases in fat were probably due to high moisture ratios in this butter [14]. Similarly, Natnael et al. reported that the fat content of butter treated with different spices and control butter increased throughout the storage time. The result was disagreed with Nadeem et al. revealed that addition of *Moringa oleifera* at different concentration did not have any negative effect on compositional attributes of butter fat content of all the treatments including control [15].

pH: Results of the changes in pH during the storage period of butter samples were illustrated in the Figure 1. pH was decreased as increasing the free fatty acid and titratable acidity (Table 2) and (Figure 2) respectively. Walstra et al. reported that lactic acid produced by lactic acid bacteria, increases the titratable acidity, while the pH decreases. The pH of control butter sample decreased faster than all butter samples from 6.2 on the zero weeks to 4 on the 4th week. This might be because of increase in free fatty acid in control butter samples than extract incorporated butter samples [16].

However, the pH of butter samples incorporated with Koseret decreased slowly from 6.2 on zero weeks to 4.59 on 4th week than control butter sample. This might due to the inhibitory effect of extracts on the lactic acid bacteria growth. The current result is in line with reports of earlier studies Najgebauer (2009) described that butter included with sage extract showed higher pH when compared to the pH of control butter during storage. Ozkan et al. also showed that the pH of butter treated with Satureja cilicica at 2%, 1% and 0.5% during storage slowed the decrease in pH value than control butter samples [17].

Table 1. *Moisture and fat content of butter treated with Fenugreek, Korarima, Koseret and their combination during storage for a month.*

Parameters										
Moisture						**Fat**				
Storage weeks	F	Kr	Ks	BHT	C	F	Kr	Ks	BHT	C
0	23 ± 1.4a	23 ± 1.5a	23 ± 1.4a	23 ± 0.7a	23 ± 1.1a	73 ± 1.1a	73 ± 1.3a	73 ± 1.4a	73 ± 1.4a	73 ± 1.46a
1	22 ± 1.4ab	20 ± 1.3abc	19 ± 1.4bc	13.5 ± 0.6d	19.5 ± 0.7a	74.5 ± 0.8ef	77 ± 1.4bcd	78.5 ± 0.9ab	79.5 ± 0.7a	73.5 ± 0.6f
2	17.5 ± 0.8ab	15.5 ± 0.7abc	14.5 ± 2cd	13.5 ± 0.6d	19.5 ± 0.7a	79.5 ± 0.8cd	82 ± 1.4abc	83 ± 1.2ab	83.5 ± 0.9a	78.5 ± 0.7d
3	16 ± 1.8ab	14 ± 1.4ab	13 ± 1.5ab	12 ± 1.6b	17 ± 1.9a	81 ± 1.4cd	83.5 ± 0.8bc	86 ± 1.3ab	87 ± 1.4a	80 ± 1.5d
4	14 ± 1.5ab	12 ± 1.3bcd	11 ± 1.4cd	10 ± 0.7d	15 ± 1.4a	82 ± 1.3de	84.5 ± 0.8bcd	87 ± 1.2ab	88 ± 1.2a	83.5 ± 0.7e
All values are average of duplicates; numbers written after BHT=Butylated hydroxyl tolune, F=Fenugreek, Kr=Korarima, Ks=Koseret, C=Control (butter without additives)										

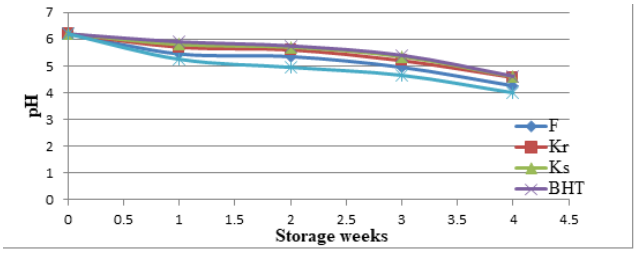

Figure 1. *pH of butter incorporated with Fenugreek, Korarima, Koseret and their mixture during storage for a month.*

Titratable acidity

Titratable acidity of butter samples increases throughout storage of 28 days. This might be due to enzymatic production of free fatty acids from triglycerides (lipolysis) and the releases of free fatty acid. High (% lactic acid) can be associated with undesirable microflora in production of butter. The relatively higher content of titratable acidity in control butter 0.08% on zero week and 0.67% on the 4th week was probably due to the amount of lactic acid obtained from butter was related to the composition of raw materials used in the butter production. While, Aslı et al. said that, due to production of undesirable micro flora in butter [18].

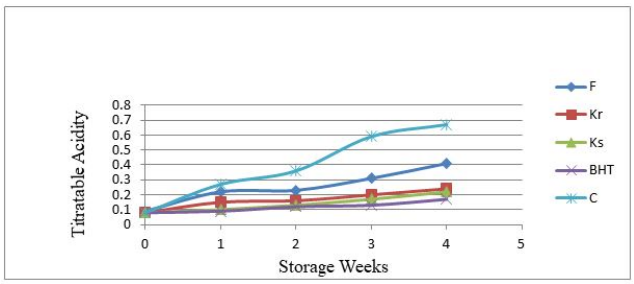

Figure 2: *Titratable acidity of butter treated with Fenugreek, Korarima, Koseret and their Titratable acidity of butter treated with Fenugreek, Korarima, Koseret and their combination during storage for a month*

Oxidative stability of butter

All values are average of duplicates; numbers written after BHT=Butylated hydroxyl tolune, F=Fenugreek, Kr=Kororima, Ks=Koseret, C=Control (butter without additives). Whereas, the lowest titratable acidity was characterized the butter treated with BHT (0.08-0.17% lactic acid) from zero to 4th week and followed by Koseret which recorded 0.08% lactic acid on the zero and 0.22% lactic acid on the 4th week as compared to other samples. This might be due to the effect of the spices used in retarding the growth of lactic acid bacteria by affecting their activity [19]. After the first week of storage the control butter samples increases faster than all butter samples. The present study was supported by the result of Ozkan et al. that showed the titratable acidity of butter treated with Satureja cilicica at 2%, 1% and 0.5% during storage retards the increase in % lactic acid content than control butter sample (without Satureja cilicica) [20].

Free fatty acid value

Free fatty acids are associated with keeping quality of fats and fat-based foods; higher levels are associated with poor keeping quality.

Table 2. *Free fatty acid and peroxide value of spiced butter during storage.*

Parameter	Storage weeks	F	Kr	Ks	BHT	C
Free fatty acid	0	0.24 ± 0.1^{a}	0.2 ± 0.05^{a}	0.2 ± 0.05^{a}	0.2 ± 0.06^{a}	0.24 ± 0.1^{a}
	1	0.6 ± 0.1^{b}	0.4 ± 0.1^{bc}	0.4 ± 0.1^{bc}	0.28 ± 0.2^{c}	1.12 ± 0.1^{a}
	2	1.1 ± 0.1^{b}	0.6 ± 0.2^{bc}	0.56 ± 0.2^{c}	0.52 ± 0.2^{c}	2.21 ± 0.3^{a}
	3	1.85 ± 0.7^{b}	1.25 ± 0.1^{bc}	1.1 ± 0.1^{c}	0.9 ± 0.1^{d}	2.6 ± 0.3^{a}
	4	2.5 ± 0.2^{ab}	1.7 ± 0.1^{b}	1.3 ± 0.1^{c}	1.15 ± 0.2^{d}	3.76 ± 0.37^{a}
Peroxide value	0	0.34 ± 0.01^{a}	0.33 ± 0.0^{a}	0.34 ± 0.03^{a}	0.32 ± 0.05 ^{a}	0.34 ± 0.02^{a}
	1	7.4 ± 0.3^{b}	5.4 ± 1.4^{bcd}	4.4 ± 0.56d^{e}	3.2 ± 0.56^{e}	9.8 ± 0.8^{a}
	2	11.8 ± 2^{b}	10.2 ± 1.4^{bc}	9 ± 1.3^{bc}	7.6 ± 0.57^{c}	15.6 ± 0.51^{a}
	3	14.4 ± 1.13^{b}	11.8 ± 0.3^{bc}	9.8 ± 0.8^{de}	9 ± 1.4^{e}	20 ± 2.1^{a}
	4	17.6 ± 1^{b}	14 ± 0.56^{cde}	11.8 ± 1.14^{e}	11.4 ± 0.8^{e}	23.6 ± 0.55^{a}

Values are mean ± standard deviation; the means with the same letter across the row are significantly different at p<0.05. All values are average of duplicates; BHT=Butylated hydroxyl tolune, F=Fenugreek, Kr=Korarima, Ks=Koseret, C=Control (butter without additives)

Table 5 showed the changes in free fatty acid values. The increase in free fatty acid value of all the treatments and control during the storage of 28 days was due to consequence of hydrolytic fat decomposition into free fatty acids by heating and oxidation. High moisture stimulates lipase activity, the growth of microorganisms and hydrolysis of the triglycerides. The presence of high moisture content in control butter sample (Table 1) leads to accelerate the formation of free fatty acids from 0.24% of oleic acid on the zero week to 3.76% on the 4th week (Table 2) than other treatments. However, low moisture content in Koseret butter sample slows formation of free fatty acid value of Koseret to 0.24% of oleic acid on the zero weeks and 1.34% on the 4th week. This result supported by Ayar et al. for instance described that methanolic extracts of sage, rosemary and oregano were effective in retardation of free fatty acid in butter during storage. As mentioned by Gebrehana et al. water extracts of thymus was effective in slowing free fatty acid than control samples of butter (without additives) during storage.

Peroxide value

Peroxide value also presented an upward trend during storage values were even higher as the fat contains a higher proportion of unsaturated fatty acids and then registering a decline due to the division of peroxides into secondary oxidation compounds. In the current study, the peroxide value of all treatments and control increased throughout the storage period of 28 days due to the autocatalytic nature of the lipid oxidation reaction. Control butter sample showed highest peroxide value when compared to extract treated butter samples from 0.34 on zero weeks to 23.6 on the 4th week meq peroxide. Kg^{-1} fat. This might be due to the presence of prooxidants which speeded the auto oxidation process and yielded higher concentrations of oxidation product. While, the lowest peroxide value was observed in butter samples included Koseret added butter samples that had the lowest PV 0.34 meq peroxide. kg^{-1} fat on zero week and 11.8 meq peroxide. kg^{-1} fat on the 4th week among extract added butter. This is because of high Antioxidant activities found in the extracts. The degree of fat oxidation could be estimated by determining peroxide value of fat, the lower peroxide values, the better the quality of fats. So, control butter sample with high peroxide value has the lowest quality of fats. These values are far in excess of acceptable values of a PV of 10 as storage time increases. That the PV of Koseret and BHT after 3rd week of storage were greater than 10. This result was supported by Ayar et al. for instance described that methanolic extracts of oregano were effective in retardation of peroxide value in butter during storage. On the other hand reported that the addition of sage on butter did not retard peroxide formation in butter during storage.

Thiobarbituric acid test

The decrease in % of inhibition shows (increase in TBARS). The development of the TBARS in butter samples is presented in Figure 3.

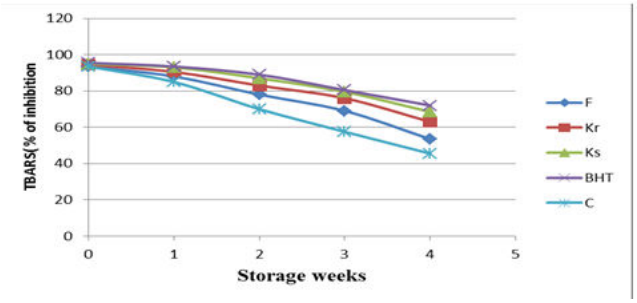

Figure 3. *Thiobarbituric acid reactive substances (TBARS) of butter treated with extracts, Control and BHT during storage for a month.*All values are average of duplicates; numbers written after BHT=Butylated hydroxyl tolune, F=Fenugreek, Kr=Korarima, Ks=Koseret.*

A comparison of secondary products of lipid peroxidation measured as percentage of inhibition of TBARS was shown in Figure 3. The percentage of inhibition values were found to be higher in Koseret incorporated butter compared to Fenugreek and korarima incorporated butter throughout the storage days. On the 4th week of storage, the percentage of inhibition of was in the order BHT (**±**%)>koseret (***)>******

An increase in TBARS in butter sample was noticeable throughout the storage time. The highest value was reported for the Fenugreek treated butter samples (the lowest % of inhibition) 92.5% inhibition on zero weeks and 70% inhibition

on the 4th week. On the other hand, butter treated with Koseret showed the highest 96.5% of inhibition on the zero week and 79% on the 4th week. This might be due to effective in inhabiting the increase in secondary oxidation products by antioxidants. Except, butter samples stored at zero week, butter samples treated with BHT and Koseret were significantly different ($p>0.05$) from other samples. The current result confirmed with the studies of Najgebauer et al. who showed that addition of methanol extract of sage and rosemary butter exhibited much lower level of TBA reacting substances (TBARS) than natural butter.

Microbial load of Butter samples

In the present study, the microbial loads of butter samples were evaluated on TAMC, YMC and TEC. In these experiments, BHT was used as a positive reference due to its bactericidal properties. Butter without any extracts was used as a negative control. The results shown in (Table 3) below indicate that all treatments, except control have the potential to inhibit the test microorganisms (TAMB, TYM and TE).

Table 3. *Microbiological of spiced butter during storage.*

Parameter	Storage weeks	F	Kr	Ks	BHT	C
TAMC	0	4.65 ± 0.07^{ab}	4.49 ± 0.02^{bc}	4.45 ± 0.07^{c}	4.4 ± 0.06^{c}	4.67 ± 0.04^{a}
	1	4.9 ± 0.04^{b}	4.8 ± 0.02^{cde}	4.77 ± 0.04^{de}	4.7 ± 0.12^{e}	5.1 ± 0.02^{a}
	2	5.2 ± 0.06^{b}	5.1 ± 0.02^{f}	5.07 ± 0.03^{f}	5.05 ± 0.07^{g}	5.4 ± 0.01^{a}
	3	5.86 ± 0.03^{b}	5.64 ± 0.01^{e}	5.55 ± 0.07^{e}	5.48 ± 0.03^{ef}	6 ± 0.01^{a}
	4	5.94 ± 0.05^{b}	5.74 ± 0.04^{bc}	5.72 ± 0.05^{c}	5.7 ± 0.01^{d}	6.5 ± 0.01^{a}
YMC	0	3.6 ± 0.08^{ab}	3.54 ± 0.04^{ef}	3.52 ± 0.01^{fg}	3.5 ± 0.06^{g}	3.61 ± 0.01^{a}
	1	3.74 ± 0.04^{b}	3.65 ± 0.02^{e}	3.62 ± 0.01^{f}	3.61 ± 0.03^{f}	4.1 ± 0.01^{a}
	2	4.93 ± 0.04^{ab}	$4.57 \pm 0.04d^{e}$	4.5 ± 0.05^{f}	4.44 ± 0.05^{f}	5 ± 0.02^{a}
	3	5.45 ± 0.07^{b}	5.1 ± 0.03^{f}	5.04 ± 0.03^{f}	4.98 ± 0.04^{g}	5.7 ± 0.09^{a}
	4	5.75 ± 0.2^{b}	5.4 ± 0.02^{de}	5.38 ± 0.03^{e}	5.35 ± 0.04^{f}	6 ± 0.01^{a}
Ebc	0	4.40 ± 0.01^{b}	3.84 ± 0.03^{de}	3.82 ± 0.02^{de}	3.78 ± 0.01^{e}	4.80 ± 0.08^{a}
	1	3.41 ± 0.04^{b}	3.26 ± 0.04^{def}	3.25 ± 0.02^{ef}	3.21 ± 0.01^{f}	4.03 ± 0.02^{a}
	2	2.95 ± 0.01^{b}	2.83 ± 0.02^{def}	2.80 ± 0.04^{ef}	2.77 ± 0.05^{f}	3.01 ± 0.01^{a}
	3	2.68 ± 0.05^{a}	2.35 ± 0.14^{bcd}	2.30 ± 0.14^{cd}	2.25 ± 0.09^{d}	2.70 ± 0.01^{a}
	4	2.50 ± 0.12^{a}	2.30 ± 0.18^{ab}	2.25 ± 0.09^{ab}	2.10 ± 0.19^{b}	2.60 ± 0.01^{a}

Total aerobic mesophilic plate counts

In the current study, it was noted that with increase in the number of storage days, the microbial count of all samples increased. A total aerobic mesophilic bacterial count was enumerated for different treatments of butter and during the storage as given in Table 7. The values of total aerobic mesophilic count increased throughout the storage time. This might be due to high microbial load initially present in milk and contamination during manufacture. At all four weeks of butter during storage, butter treated with Koseret showed the lowest microbial load of 4.45 log cfu/ml on the zero week (first day) and 5.72 log cfu/ml on the fourth week. This might be due to high content of phenols and flavonoids in the extract Thus, the components of *L. Adoensis var koseret* extracts are known to possess potent antimicrobial activities. On the other hand, control butter sample had the highest microbial load of 4.67 log cfu/ml on the first day (zero week) and 6.5 log cfu/ml on the 28th day (week four). This was because of post-production contamination of butter. The TAMBC of all butter samples incorporated Fenugreek, Korarima, Koseret were met Ethiopian Standard Agency, log cfu/ml up to the 2nd week. Whereas control butter sample did not met Ethiopian Standard Agency, after 1st week of storage time. This might be due to antimicrobial potential of inhibitory properties of the extracts. The results of the present study is in agreement with results of Adam et al. who reported that the samples of Fenugreek, Garlic and Cumin had the highest percentage of antimicrobial on total aerobic mesophilic bacterial count.

Total mold and yeast

The total mold and yeast of all butter samples throughout the storage period were not met Ethiopian Standard Agency, which is 1logcfu/ml mould yeast safety requirement for butter. The values of total mould and yeast increased throughout the storage time due to the low pH of butter was favorable for the growth of spoilage yeasts and mould. Koseret treated butter samples showed the lowest microbial load 3.52 cfu/ml on the zero week and 5.38 log cfu/ml on the 4th week. This was because of antagonistic effect of extracts against the growth of mould and yeast. However, the values of total mould and yeast count for control butter samples ranges from 3.61-6 log cfu/ml from zero to 4th week were higher than extract treated butter. The result of the present study is comparable with that of Gebrahana, et al. showing that the values of aerobic mould and

yeast count for control sample of butter were higher than thyme crude extract treated samples in all three weeks of butter during storage 4$^{\circ C}$ time.

Total enterobacteriaceae count

The result on total enterobacteriaceae count is shown in (Table 7). The lowest microbial load was found in butter included with Koseret that had 3.82 log cfu /ml on the zero week and 2.25 log cfu /ml on the 4th week. While, Korarima incorporated butter sample ranges from 3.84 log cfu /ml to 2.3 log cfu/ml from zero week up to 4th week. This could be due to the presence of high content of phenols and flavonoids in the extract. Thus the components *L. adoensis* extract is known to possess potent antimicrobial activities. However, control butter showed the highest microbial load of 4.8 log cfu/ml on the zero week and 2.6 log cfu /ml on the 4th week. This result confirmed with the result of Gebrahana, et al. who reported that control butter sample had the highest counts of enterobacteriaceae at all three weeks of cold storage compared to other samples treated with thyme. On the other hand, Alganesh et al. showed that from ghee, frozen butter, spiced butter, refrigerated butter and untreated butter relatively higher counts of Enterobacteriaceae was observed in spiced butter than in other treatments.

Sensory characteristics of butter

The progress of rancidity in fat is monitored by sensory evaluation until the panel detects a definite rancid or off flavour.

Table 4. Changes in sensory property of butter samples during zero and 4th storage weeks.

Storage Weeks	Treatments	Color	Smell	Texture	Appearance	Overall acceptability
Zero week	F	6.68 ± 0.4^{ab}	6.64 ± 0.49^{b}	6.56 ± 0.65^{ab}	6.56 ± 0.58^{a}	6.52 ± 0.58^{a}
	Kr	6.88 ± 0.33^{a}	6.72 ± 0.45^{ab}	6.62 ± 0.57^{ab}	6.36 ± 0.81^{ab}	6.48 ± 0.65^{a}
	Ks	6.76 ± 0.44^{b}	6.84 ± 0.65^{a}	6.64 ± 0.64^{ab}	6.6 ± 0.71^{a}	6.56 ± 0.5^{a}
	BHT	6.56 ± 0.58^{bc}	6.48 ± 0.37^{c}	6.4 ± 0.82^{ab}	6.16 ± 0.69^{b}	6.56 ± 0.71^{a}
	C	6.36 ± 0.8^{c}	6.6 ± 0.5^{bc}	6.61 ± 0.7^{ab}	6.52 ± 0.58^{ab}	6.48 ± 0.71^{a}
Fourth week	F	4.6 ± 0.5^{ab}	4.41 ± 0.58^{b}	4.4 ± 0.9^{b}	4.84 ± 0.47^{bc}	4.56 ± 0.5^{bc}
	Kr	5 ± 0.49^{a}	4.42 ± 0.63$^{a\ b}$	4.48 ± 0.65^{ab}	4.92 ± 0.49^{b}	4.72 ± 0.46^{b}
	Ks	4.4 ± 0.7^{b}	5.32 ± 0.55^{a}	4.64 ± 0.7^{a}	5.16 ± 0.69^{a}	5.1 ± 0.57^{a}
	BHT	4.9 ± 0.46^{a}	4.22 ± 1^{bc}	4.3 ± 0.76^{bc}	5 ± 0.76^{ab}	5 ± 0.8^{ab}
	C	3.28±0.6^{d}	2.88 ± 0.78^{c}	3.2 ± 0.62^{c}	3.32 ± 0.98^{c}	3.36 ± 0.57^{c}

Sensory characteristics of butter samples improved as a result of treatments. Korarima for colour, Koseret for smell, texture, appearance and for overall acceptability highly than other treatments. In addition to this, reported that the colour changes depending on factors such as microbial quality and storage conditions. The current study also showed the acceptance of smell of butter declined throughout the storage weeks. This might be due to off-flavours developing from lipid oxidation. In addition, reported that the colour; flavour, appearance and overall acceptability of butter during storage decreased.

Conclusion

Traditional butter preservation methods used in this study are spicing with different spices Fenugreek, Korarima and Koseret. In this finding, the butter treated with Koseret strongly retarded the oxidation of butter and total aerobic mesophilic bacteria, yeast and mold count and enterobacteriaceae of all butter samples were highly lower than control butter. Similarly butter incorporated Koseret showed better sensory acceptability than Korarima and Fenugreek treated butter. Based on the findings of this study and the conclusion made, the following are recommended for further study:

Further studies should be required to identify the effect of thermal treatment on the individual phenolic compounds from each spice and herb extracts.

Further study is needed to improve the quality of Butter using these spices and herbs at room and refrigerated temperature.

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Authors' Contribution

Genet shiferaw from proposal writing, laboratory work, data Analysis and research writing and Editing. Engdea Dessalegn, from proposal editing, laboratory work and research editing. Yassin Hassen, from proposal editing, laboratory work and research editing.

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