J. Food and Dairy Sci., Mansoura Univ., Vol. 8 (3): 145- 150, 2017

Oxidative Stability of Buffaloes' Butter-Oil Treated with Herb and Spices Extracts in the Presence of Ferric Ions during Storage Period.

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ABSTRACT

Oxidative rancidity in butter oil leads to decrease in its shelf life. Use of synthetic antioxidants is prevalent in dairy industry to inhibit oxidative rancidity. Effects of hydro-alcohol extracts of black pepper (*P.nigrum Linn.)* , coriander (*Coriandrum Sativium*) , and sage (*Salvia officinalis Linn.)* on butter oil stability were investigated and all extracts were individually added to buffalo butter oil at 0.5% and synthetic antioxidant Butylated hydroxyl anisole (BHA) at rate of 0.02% and control sample in the presence of ferric ions. The peroxide value (PV), acid value (AV), free fatty acid (FFA), radical scavenging activity (DPPH), reheological and sensory properties were determined at regular intervals for all samples. The black pepper extract showed the highest total phenolic content (526.19 mg GAE/100 ml extract). Buffalo butter oil treated with 0.5% coriander extract showed the lowest value for acid value (0.93±0.06 mg KOH/g fat) and peroxide value (0.80 ±0.04 meq.O_2/g fat) at the end of storage. Herb and spices extracts exhibited a significant effective in retarding the deterioration of butter oil comparing to control as observed during storage periods.

Keywords: black pepper, coriander, sage, butter-oil, Oxidative rancidity and oxidative stability.

INTRODUCTION

Codex Alimentarius defines butter oil as product obtained from milk, cream or butter by different methods, which result in removal of most water and nonfat milk solids, with an especially advanced flavor and physical structure Codex, (2007).

There has been great interest in evaluating essential oils and various plant extracts for natural antioxidants because of their good antioxidant properties. In order to extend the shelf life of foods, various synthetic antioxidants such as (BHT) and (BHA) are used currently, but these substances are in compatible for human consumption, because of their toxic properties for human health and the environment (Ito *et al*. 1986 and Stich 1991).

The interaction between lipid hydro-peroxides and trace metals is believed to be the most important provider of lipid oxidation in foods and biological systems Frankel, (2005). McClements and Decker (2008) defined Pro-oxidants as a component that cause lipid oxidation by direct interactions with unsaturated fatty acids, or by enhancing formatting of free radicals. Samarin *et al*., (2012) reported that oxidation reaction may include highly reaction molecules called free radicals. Free radicals are molecules that have lost an electron and try to replace it by reacting with other molecules. This causes the substance to deteriorate. In food this reactions can lead to rancidity, loss of nutritional value from the damage of vitamins (A,D,E and K) and essential fatty acids and the possible formation of toxic components and colored productions. Natural extracts of herbs and spices rich in phenolics are using in food industry because it retarding oxidative deterioration of lipids and improve the quality and nutritional value of food (Rowan, 2000).

Patel *et al*. (2013) assessed the effect of coriander extract in ghee they reported that coriander extract added ghee gave better oxidative stability of ghee during storage as compare to control sample but they also suggested that for ghee BHA is more effective antioxidant than coriander extract. Al-Qudah *et al*., (2014) found that Salvia is a rich source of phytochemicals including phenolic acids, polyphenols, flavonoid glycosides, anthocyanins, sesquiterpenoids, diterpenoids, sesterterpenes and triterpenes. The volatile oil and pungent components are the two main compounds of black pepper. The alkaloid, piperine, is the main contribution to pungency whereas essential oil components like α- and β- pinene, limonene, myrcene, linalool, α- phellandrene, sabinene, β-caryophyllene, germacrene- D, etc., are the major odor and taste components of pepper Jirovetz *et al*., (2002). The objectives of this invistigation were to assess total phenolic content, radical scavenging activity using DPPH assay of the herbs extracts and to evaluate the effect of added herbs extracts on oxidative stability of butter-oil during storage.

MATERIALS AND METHODS

1.Materials:

Fresh whole buffaloes' butter was obtained from Agricultural Research Center, Giza, Egypt. Black pepper *(Piper nigrum L.)*, Coriander *(Corianderum sativum L.)*, and Sage *(Saliva officinalis L.)* were obtained from local market (Cairo, Egypt).

2. Analytical Methods:

Total phenolic content of herb and spices extracts was analysed according (Kahkonen *et al*., 1999) Results were expressed as mg of Gallic acid equivalents (GAE) per 100 ml of extrac . The RSA of herb and spices extracts was assessed by the decolouration methanolic solution of DPPH radical (0.02/ 1000ml methanol) according to (Blois, 2001).

Peroxide value of butter oil samples was determined according to (A.O.A.C. 2000). Acid number and free fatty acid values were determined according to (A.O.A.C. 2000). The penetration of butter oil samples was evaluated in triplicate for each batch of butter oil at room temperature (28 ±1ºC). Each sample was subjected to a one cycle of penetration. Calculation described by Bourne, (1978) was used to obtain the final parameters. The ability of antioxidants to quench DPPH radicals in butter oil was determined after oxidation tests (Espin *et al*. 2000). The extracts were prepared as described by Shahidi, (2012). Ferric palmitate, a lipid soluble compound, was added to fresh butter oil to investigate the effect of the (BP, Co, S) extracts on the

oxidative stability of butter oil with 2.2 ppm Fe^{+3}. The ferric palmitate was prepared as previously described by Gordon and Weng (1992).

Preparation of butter oil and addition of antioxidants

Buffaloes' butter was separately converted into butter oil by boiling off at 140 – 180°C for four hours. The resultant butter oil was left to cool down to 55°C. As well as, the residues was well precipitated, then filtrated through muslin to obtain the very light green buffalo's butter oil and the clear yellow cow's butter oil as described by (El- Saadany, 2003).

Experiment design:

Extracts of Black pepper, coriander and sage were added to oxidized buffalo butter oil with 2.2 ppm Fe^{+3} (32.35 mg ferric palmitate per Kg fat) at rate of 0.5% (W/W) respectively. Synthetic antioxidant (BHA) was added directly to oxidized buffalo butter oil at the rate of 0.02% (w/w). Samples stored for 21st days at ambient temperature. All the obtained data were statistically analyzed by SPSS ver.16computer software (Artimage and Berry 1987).

RESULTS AND DISCUSSION

Total phenolic content:

Total phenolic content (TPC) of herb and spices extracts was determined by using Folin-Ciocalteu reagent (Haung *et al*., 2005). Plant phenolics one of the main combinations of the components acting as primary antioxidants or free radicals terminator (Zeyada *et al*., 2007). Results of the colorimetric analysis of total phenolics given in Table (1). The results clearly showed that the highest concentration in phenolic compounds was determined for black pepper extract (526.19mg GAE/ 100ml), followed by coriander extract (511.8 mg GAE/ 100ml), and sage extract (228.82mg GAE/ 100ml). The differences between the results of herb and spices used in this study were due to difference in solubility of antioxidative components in the solvent (hydro-alcohol extract) or due to the difference in the temperatures used in their preparation.

Table 1. Total phenolics contents of Black pepper, Coriander and Sage extract (mg/100g):

Samples	Black pepper (*Piper nigrum L.*)	Sage (*Salvia officinalis L.*)	Coriander (*Coriandrum sativum L.*)
Total phenolic content (mg *of* GAE/100ml extract	526.19	228.82	511.8

Radical scavenging activity (DPPH%) of black pepper, coriander, and sage extracts:

The radical scavenging activity (%) of black pepper, coriander and sage extracts were evaluated at different concentrations (40, 60,80and 100µg/ml) extract in the DPPH system. It was observed that the radical scavenging activity showed highest antioxidant activity for sage extract followed by coriander extract and black pepper extract give the lowest antioxidant activity respectively as shown in Fig. (1).

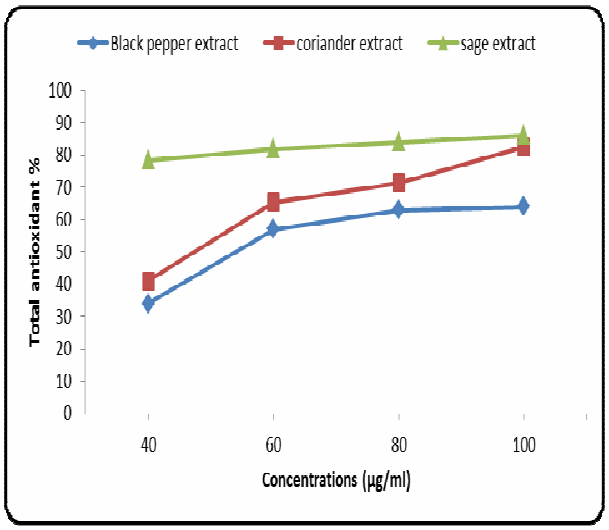

Fig. 1. Radical scavenging activity of black pepper, coriander, and sage extracts at different concentrations.

Peroxide value:

Peroxide value (PV) represents primary reaction products of lipid oxidation, which can be measured by their ability to liberate iodine from potassium iodide. It is considered to represent the quantity of active oxygen (mg) contained in 1 g of lipid (Pawar *et al*., 2014). The autoxidation of lipids could be attributed to the decomposition of lipid hydroperoxides by ferric and ferrous ions to give lipid peroxyl and alkoxyl radicals which begin the free radical chain oxidation (Yamamoto and Niki 1988). The effect of addition herb and spices extracts and synthetic antioxidants on peroxides values of buffalo butter oil treated samples stored at ambient temperature for 21 days was evaluated, and the results are given in Table (2).

As the samples were subjected to metals oxidation with ferric palmitate, significant ($P<0.05$) decrease in peroxide was noticed in comparing with control buffalo butter oil in the presence of ferric ions, which increased remarkably during storage. During storage all treatments showed a statistically significant effect of preventing peroxide formation.

At the end of storage period after 21st day data revealed that peroxide value for all investigated samples showed significant ($P\leq0.05$) decreased comparing with control buffalo butter oil. The peroxide value of control buffalo butter oil increased from (0.0 to 1.61±0.04 meq. O_2/ g fat). Butter oil containing 0.5% coriander extract showed a minimum peroxide value (0.80±0.04 meq. O_2/ g fat) compared with other extracts and control buffalo butter oil samples and BHA in the presence of ferric ions at ambient temperature.

Acid value

Acid value of both buffalo butter oil and buffalo butter oil treated with different extracts were determined using titration method and the results are shown in Table (3) they derived from the titration of both untreated and samples treated with different extracts. Acid value results are expressed as milligram KOH

alcohol per gram of butter oil. At the end of storage, after 21st days butter oil samples containing 0.5 % coriander extract showed significantly decrease in acid value followed by the samples containing 0.5% black pepper extract and 0.5% sage extract comparing with control buffalo butter oil samples in the presence of ferric ions.

Darughe *et al.,* (2012) illustrated the effect of coriander essential oil in cake and they found that coriander essential oil at 0.05, 0.10 and 0.15% prevented the formation of peroxide in cake and their effects were similar to BHA at 0.02 % ($p<0.01$).

Table 2. Effect of adding BHA or black pepper extract, coriander extract and sage extract at different concentrations on peroxide value (meq.O_2/g fat) of buffalo butter oil during storage at ambient temperature:

Storage period(days)	(BBO +2.2 ppm Fe^{3+})	(BBO+2.2 ppm Fe^{3+}) +BHA	(BBO+2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+2.2 ppm Fe^{3+})+S 0.5%
0	a 0	a 0	a 0	a 0	a 0
3	ef 0.89 ±0.06	d* 0.78 ±0.03	c* 0.57 ±0.06	ab* 0.32 ±0.01	a* 0.26 ±0.01
6	e 0.99 ±0.04	de* 0.87 ±0.04	c* 0.64 ±0.06	ab* 0.36 ±0.03	a* 0.29 ±0.03
9	d 1.06 ±0.03	c* 0.95 ±0.06	b* 0.69 ±0.06	a* 0.44 ±0.06	a* 0.38 ±0.06
12	d 1.19 ±0.04	c* 1.11±0.03	b* 0.85 ±0.07	a* 0.53 ±0.04	a* 0.49 ±0.07
15	d 1.29 ±0.03	c* 1.08 ±0.6	c* 1.08 ±0.11	a* 0.59 ±0.03	ab* 0.66 ±0.09
18	e 1.40 ±0.05	d* 1.29 ±0.03	c 1.17 ±0.07	a* 0.66 ±0.03	b* 0.78 ±0.04
21	e 1.61 ±0.04	d* 1.50 ±0.07	c* 1.27 ±0.06	a* 0.80 ±0.04	b* 0.92 ±0.03

a, b, c, d, e, Means (±standard deviation) in the same row with different letters are significant with control

Table 3. Effect of adding BHA or black pepper extract, coriander extract, sage extract at different concentrations on the acid number of buffalo butter oil during storage at ambient temperature:

Storage period (days)	(BBO +2.2 ppm Fe^{3+})	(BBO+2.2 ppm Fe^{3+}) +BHA	(BBO+2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+2.2 ppm Fe^{3+})+S 0.5%
0	cd 0.63±0.06	bcd 0.60±0.06	ab* 0.49±0.06	ab* 0.49±0.06	a* 0.45 ±0.01
3	a 1.60±0.34	a 1.61±0.34	bcd 1.75±0.06	cde 1.83±0.06	bcd 1.75 ±0.13
6	abcd 2.09±0.33	abc 1.83±0.13	abc 1.98±0.07	abc 1.90±0.01	bcd 2.20 ±0.52
9	de 2.45± 0.29	cd 2.28±0.45	bc 2.24±0.11	ab* 2.05±0.06	a* 1.98 ±0.17
12	d 2.28±0.13	bcd 2.09±0.26	abc* 1.94±0.07	bcd 2.05±0.13	a* 1.72 ±0.13
15	d 1.79±0.29	bcd 1.69±0.09	ab 1.57±0.19	bc 1.64±0.06	a* 1.42 ±0.13
18	bc 1.64±0.36	abc 1.53±0.17	ab 1.34±0.11	a* 1.16±0.13	ab 1.27 ±0.17
21	c 1.64±0.17	ab 1.08±0.26	ab* 1.23±0.13	a* 0.93±0.06	ab* 1.16 ±0.06

a, b, c, d, Means (±standard deviation) in the same row with different letters are significant with control

Free fatty acid %:

The free fatty acid content of butter oil is measure the extension of hydrolytic and lipolytic rancidity in butter oil. Table (4) Contains mean and standard deviation of FFA data of the treated butter oil samples stored at ambient temperature. Formation of free fatty acids might be an important measure of rancidity in oil and fats. After 21st day of storage at ambient temperature all treated samples showed a significant ($P\leq0.05$) decrease in free fatty acid. The lowest mean value of free fatty acid observed for the samples treated with 0.5% coriander extract (0.47±0.03% oleic acid). The highest mean value of free fatty acid observed for control buffalo butter oil samples (0.83±0.09% oleic acid).The obtained results agreement with (Ayar *et al*., 2001) found that methanolic extracts of sage, rosemary and oregano were effective in retardating of oxidation and lypolisis processes in butter.

Table 4. Effect of adding BHA or black pepper extract, coriander extract, sage extract at different concentrations on Free fatty acids (Oleic acid%) content of buffalo butter oil during storage at ambient temperature:

Storage period (days)	(BBO +2.2 ppm Fe^{3+})	(BBO+ 2.2 ppm Fe^{3+}) +BHA	(BBO+ 2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+ 2.2 ppm Fe^{3+})+S 0.5%
0	bcd 0.32±0.03	abc 0.31±0.06	ab* 0.25±0.03	ab* 0.25±0.02	a* 0.23±0.01
3	ab 0.81±0.17	bc 0.89±0.06	bcd 0.91±0.07	bcd 0.95±0.03	bc 0.89±0.06
6	abc 1.05±0.17	ab 0.92±0.06	ab 0.99±0.03	ab 0.96±0.01	abc 1.11±0.26
9	cd 1.23±0.15	abcd 1.14±0.23	abcd 1.13±0.06	ab* 1.03±0.03	a* 1.00±0.08
12	cde 1.09±0.08	abc 0.99±0.12	abc 0.98±0.03	bcd 1.03±0.07	a* 0.86±0.06
15	cde 0.90±0.15	abcd 0.87±0.03	abc 0.77±0.13	abcd 0.83±0.03	a* 0.68±0.12
18	ab 0.83±0.18	ab 0.77±0.09	ab 0.73±0.06	a* 0.58±0.06	a 0.64±0.09
21	c 0.83±0.09	c 0.81±0.13	ab* 0.55±0.06	a* 0.47±0.03	ab* 0.58±0.03

a, b,c,d, and e. Means (±SD) in the same row with different letters are Significant with control.

Radical scavenging activity (RSA) of butter oil by DPPH assay:

Radical scavenging activity of butter oil treated samples with extracts, BHA and control was evaluated by (2,2- diphenyl- 1- picrylhydrazyl) assay. The DPPH assay measures the potential to quench the DPPH radical's storage at ambient temperature and the results are presented in Table (5). After 21st day of storage at ambient temperature all butter oil treated samples with different antioxidants extracts and butter oil treated with BHA showed significant different ($P \leq 0.05$) in comparing with control buffalo butter oil in the presence of ferric ions. Butter oil sample treated with BHA(71.26 ±0.05%) showed highest activity in quenching DPPH radicals followed by butter oil treated with 0.5% sage extract, 0.5% coriander extract, and 0.5% black pepper extract in the presence of ferric ions (70.15±0.02, 62.12±0.01, 60.51±0.01%) respectively. Patel *et al*., (2013) assessed the antioxidant activity of coriander extract in ghee and reported that coriander extract added ghee gave better oxidative stability of ghee during storage as compare to control sample but they also suggested that for ghee BHA ismore effective antioxidant than coriander extract.

Table 5. Effect of adding BHA or black pepper extract, coriander extract, sage extract at different concentrations on the radical scavenging activity % of buffalo butter oil during storage at ambient temperature:

Storage period (days)	(BBO +2.2 ppm Fe^{3+})	(BBO+2.2 ppm Fe^{3+}) +BHA	(BBO+2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+2.2 ppm Fe^{3+})+S 0.5%
0	e* 71.63±0.55	a* 85.27±0.04	c* 78.85±0.01	d* 74.50±0.01	b* 81.46±0.01
12	e* 52.46±0.04	a* 80.23±0.03	d* 62.18±0.01	c* 64.76±0.01	b* 72.70±0.01
21	e* 43.16±0.05	a* 71.26±0.05	d* 60.51±0.01	c* 62.12±0.01	b* 70.15±0.02

a, b,c,d, and e. Means (±SD) in the same row with different letters are Significant with control.

Texture profile analysis:

Texture profile analysis of buffalo butter oil treated samples with different extracts was given in Table (6). Hardness is defined as the characteristic that describes a product which displays substantial resistance to deformation or breaking (Rosenthal, 1999).

The hardness values of treated buffalo butter oil samples with extracts showed significant ($P \leq 0.05$) increase in comparing with control buffalo butter oil. All treated buffalo butter oil samples with extracts and control buffalo butter oil sample showed significant ($P \leq 0.05$) decrease in hardness values during 21st day of storage. The highest mean hardness value recorded for the samples treated with o.5% coriander extract, (64.73±0.15), comparing with control buffalo butter oil sample in the presence of ferric ions (48.20±1.59). The results described that plant extracts soften the structure. Also, texture properties are affecting by differences in chemical composition and physical structure of butter oil, herb and spices added and concentration used. The difference in results between extracts used may be attributed to hydrophilic and lipophillic nature of antioxidative compounds in herbs.

Table 6. Effect of adding BHA or black pepper extract, coriander extract, sage extract at different concentrations on hardness of buffalo butter oil during storage:

Storage period (days)	(BBO +2.2 ppm Fe^{3+})	(BBO+2.2 ppm Fe^{3+}) +BHA	(BBO+2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+2.2 ppm Fe^{3+})+S 0.5%
0	d 61.83±0.45	e* 50.27±0.50	c* 120.96±0.30	a* 138.60±0.06	b* 130.90±0.05
12	e 53.80±0.27	f 49.37±0.40	cd* 89.20±0.05	a* 100.67±0.55	bc* 93.80±0.10
21	d 48.20±1.59	d* 46.23±0.55	b* 61.41±0.06	a* 64.73±0.15	c* 60.80±0.10

a, b,c,d, and e. Means (±SD) in the same row with different letters are Significant with control.

Sensory evaluation:

Sensory evaluation values for fresh buffalo butter oil samples treated with different extracts at different concentrations in the presence of ferric ions and stored for 21st days at ambient temperature were summarized in Table (7).

Sensory attributes evaluated (color, odor, consistency, and over all acceptability) provided a useful information on the changes due to the treatments with BHA and black pepper, coriander, and sage extracts.

Significant decrease ($P \leq 0.05$) was recorded in color, odor, consistency and overall acceptability for all treated samples and control during 21st day of storage at ambient temperature. The highest mean values for color, odor, consistency and overall acceptability recorded for buffalo butter oil treated with 0.5% coriander extract (5.27±0.25, 6.93±0.51, 6.67±0.25, 6.76±0.25) respectively, and the lowest mean values for color, odor, consistency and overall acceptability recorded for buffalo butter oil treated with 0.5% sage extract (4.80±0.20, 5.93±0.60, 6.23±0.40, 5.43±0.40) comparing with control butter oil samples with 2.2ppm Fe+3 (5.50±0.50, 6.93±0.12, 6.17±0.15, 5.21±0.87).

Table 7. Effect of adding BHA or black pepper extract, coriander extract, sage extract at different concentrations on sensory properties of buffalo butter oil in the presence of ferric ions during storag at ambient temperature:

	Parameters	(BBO +2.2 ppm Fe^{3+})	(BBO+2.2 ppm Fe^{3+}) + BHA	(BBO+2.2 ppm Fe^{3+})+BP 0.5%	(BBO+2.2 ppm Fe^{3+})+Co 0.5%	(BBO+2.2 ppm Fe^{3+})+S 0.5%
Color	0	ab 7.70±0.45	a 8.30±0.27	abc 8.10±0.22	a 8.30±0.27	ab 8.00±0.11
	12	b 7.00±0.05	cd* 6.47±0.25	b* 7.23±0.24	a* 8.33±0.15	b * 7.27±0.23
	21	c 6.00±0.20	b 6.07±0.12	b* 6.60±0.17	a* 7.50±0.30	bc 6.37±0.15
Odor	0	ab 8.00±0.11	a 8.20±0.45	ab 8.20±0.44	ab 8.10±0.22	abc 7.80±0.41
	12	abc 7.53±0.25	abc 7.67±0.15	abc 7.50±0.50	ab 8.10±0.36	bcd 7.23±0.23
	21	ab 7.10±0.10	bc 6.97±0.15	cd 6.86±0.32	a 7.50±0.50	e* 6.00±0.32
Consistency	0	cde 7.80±0.27	ab 8.50±0.11	abcd 8.00±0.03	abc 8.20±0.28	bcd 7.80±0.45
	12	abcd 7.36±0.51	ab 7.90±0.36	bcde 7.30±0.17	abcd 7.66±0.15	de 7.00±0.50
	21	cd 7.15±0.76	ab* 7.36±0.32	bcd* 6.77±0.25	abc* 7.00±0.21	cd*** 6.50±0.50
Acceptability	0	ab 8.00±0.35	abc 8.10±0.55	ab 8.00±0.11	abc 8.40±0.22	bcd 7.80±0.27
	12	cd 6.97±0.45	bc 7.27±0.31	bc 7.40±0.10	a* 8.03±0.25	bc 7.26±0.25
	21	e 5.60±0.66	bcd* 6.80±0.20	cd* 6.70±0.17	ab*** 7.37±0.32	cd*** 6.60±0.10

a, b,c,d, and e. Means (±SD) in the same row with different letters are Significant with control.

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الثبات التأكسدى للسمن الجاموسى المعامل بمستخلصات الأعشاب والتوابل فى وجود أيونات الحديدك خلال فترة التخزين

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يؤدى أكسدة السمن (التزنخ الأوكسيدى) إلى خفض فترة صلاحيتها. إستخدام مضادات الأكسدة الصناعية هو السائد فى صناعة الألبان وذلك لتأخير حدوث التزنخ الأوكسيدى. تم دراسة تأثير المستخلص المائى الكحولى لكل من (الفلفل الأسود – الكزبرة – المرمرية) على جودة السمن أثناء التخزين. فقد تم إضافة كل مستخلص من مستخلصات الدراسة على حدة للسمن الجاموسى بنسبة 0.5% وكذلك إستخدم مضاد الأكسدة الصناعى بيوتيل هيدروكسى أنيسول بنسبة 0.02%. وتم مقارنة جميع المعاملات بالكنترول وذلك فى وجود أيونات الحديديك لجميع المعاملات. وتم تقدير كل من رقم البيروكسيد ورقم الحامض والأحماض الدهنية الحرة والثبات التأكسدى وأيضا كل من الخواص الريولوجية والحسية على فترات منتظمة لجميع المعاملات أثناء فترة التخزين.أظهر مستخلص الفلفل الأسود إحتوائه على أعلى محتوى للفينولات الكلية (526.19 ملجم مكافىء حامض الجاليك/ 100مل من المستخلص). أوضح السمن الجاموسى المعامل بـ 0.5% من مستخلص الكزبرة أقل قيمة لرقم الحامض(0.93 ± 0.06 ملجم KOH/جم دهن) وأقل قيمة لرقم البيروكسيد (0.80 ±0.04 ملى مكافىء جزىء أكسجين / جم دهن) فى نهاية التخزين. أظهرت مستخلصات التوابل والأعشاب تأثير فعال وواضح لتأخير أكسدة السمن و ذلك عندالمقارنة بالكنترول خلال فترات التخزين.