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Production of Ghee from Braided Cheese Whey

إنتاج السمن من شرش الجبنة المضفرة

A Dissertation Submitted in Partial Fulfillment for the Requirements of B.Sc. (Honor) Degree in Food Science and Technology

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November 2020

الآيـــــة

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قال تعالى:

﴿مَثَلُ الْجَنَّةِ الَّتِي وُعِدَ الْمُتَّقُونَ فِيهَا أَنْهَارٌ مِنْ مَاءٍ غَيْرِ آسِنٍ وَأَنْهَارٌ مِنْ لَبَنٍ لَمْ يَتَغَيَّرْ طَعْمُهُ وَأَنْهَارٌ مِنْ خَمْرٍ لَذَّةٍ لِلشَّارِبِينَ وَأَنْهَارٌ مِنْ عَسَلٍ مُصَفًّى وَلَهُمْ فِيهَا مِنْ كُلِّ الثَّمَرَاتِ وَمَغْفِرَةٌ مِنْ رَبِّهِمْ كَمَنْ هُوَ خَالِدٌ فِي النَّارِ وَسُقُوا مَاءً حَمِيمًا فَقَطَّعَ أَمْعَاءَهُمْ ﴾

(صدق الله العظيم)

سورة محمد الآية (15)

DEDICATION

To our parents,

Thanks for your great support and continuous care

To our brothers,

I am really grateful for them, they are my inspiration and soul mates

To our friends,

for their fruitful help, love and encouragement

To our teacher,

To all those who take the science of a mission to travel to through the path of knowledge and tarnished form

With respect

ACKNOWLEDGMENTS

First of all we would like to thank (ALLAH) for giving us encourage and force as well as guidance in conducting this research, despite all difficulties. Our thanks also to the supervisor of this work **Dr. Salma Elgahli Mustafa** for her guidance.

Our special thanks go to **T. Eljali** for his various kinds of support during the experimental studies.

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ABSTRACT

This study was conducted to produce ghee from braided cheese whey, The Chemical composition analysis of whey, butter and ghee were determined (moisture , protein, fat, ash, lactose).

The physicochemical and sensory properties of ghee were identified (peroxide value, density and viscosity)

The results of chemical composition for whey (93.7, 0.86, 0.61, 0.48, 4.35), butter (46.47, 8.4, 33.13,3.5, 8.48) and ghee (0.45, 2.11, 91.97, 0.37,5.10) respectively for moisture, protein fat, ash, and lactose

The results of physicochemical properties of ghee (2.47, 0.9109, 39.29) respectively for peroxide value, density and viscosity.

The results of the sensory evaluation of the color, taste, and general acceptance of the product by a number of connoisseurs (15) did not show significant differences except for the flavor that was characterized by a higher of acceptance, the product was characterized by a higher degree of acceptance compared to ghee made from butter milk. From this study we conclude that ghee made from braided cheese whey has nutritional value that can be used in the manufacture of bakery and pastries.

ملخص الدراسة

أجريت هذه الدراسة لإنتاج السمن من شرش الجبنه المضفرة، وتحليل التركيب الكيميائي للشرش ،زبدة الشرش والسمن(الرطوبة ،البروتين، الدهون، الرماد واللاكتوز) وتم تحديد الخصائص الفيزيائية الكيمائية(قيمه البيروكسيد ، الكثافه واللزوجة) والخصائص الحسية للسمن.

أظهرت نتائج التحليل الكيميائي للشرش (93.7 , 0.68 , 0.61 , 435)،زبدةالشرش(46.47, 8.4, 8.48, 33.13,3.5) والسمن (0.45,2.11,91.97,0.37,5.10) للرطوبه ، البروتين ، الدهن ،الرماد ،واللاكتوزعلي التوالي. كما أظهرت نتائج الخصائص الفيزيائية الكيمائية للسمن (2.47,0.9109,39.29) علي التوالي لقيمه البيروكسيد ، الكثافة واللزوجه.

ولم تظهر نتائج التقييم الحسي للون ، الطعم، القوام والقبول العام للمنتج من خلال عدد من المتذوقين (15) فروقآ معنوية عدا في النكهة ، تميز المنتج بدرجة قبول أعلي مقارنة مع السمن المصنع من زبدة الحليب. ومن هذه الدراسة نلخص إلي أن السمن المصنع من شرش الجبنة المضفرة ذات قيمة غذائية يمكن أن يستفاد منها في صناعة المخبوزات والمعجنات .

CHAPTER ONE

INTRODUCTION

Cheese is an ancient food, it is said that its roots go back to history; it goes back to the method of transporting milk in the bladder taken from the stomach of ruminants, as it is the original source of rennet. Cheese industry became an advanced enterprise from the birth of ancient Rome (Nibble, 2009). Cheese is most diverse group of dairy products that is widely produced and consumed worldwide. It provides a high concentration of nutrients relative to its energy content. The nutritional composition of cheese depends on the type of milk used and the manufacturing and ripening procedures (Ucuncu, 2004).The gross composition of cheese milk , especially the concentrations of protein , casein and fat , has a major influence on several aspects of cheese manufacture and ripening (Fox and McSweeny 2004).

Whey is greenish-yellow aqueous portion of milk when coagulum is separated during manufacture of cheese, paneer, chhana, and casein. Whey is representing 80-90%volume of transformed milk (Moreno-indias *et al*., 2009).

The word ghee is evolved from word ghruta. Ghee is a common Indian name for clarified butter fat. The origin of ghee making probably lies far beyond recorded history. The word itself stems from the old Sanskrit ghr which means bright or to make bright when sprinkled on fire, butterfat enhanced its brightness merged with cause. Butterfat was later christened ghruta, which evolved into ghee. Ghee is known by various names in various languages corresponding to products in which it is contained (Intrenational Dairy Federation, 1958).

Main objective:

Whey is produced in high amount as by product of cheese production process so this study was conducted to use whey of braided cheese for production ghee.

Specific objectives:

- To determine the chemical composition of whey, butter and ghee.
- To determine physicochemical properties of ghee.
- To evaluate the sensory properties of ghee.

CHAPTER TWO

LITERATURE REVIEW

2.1 Cheese:

Cheese ripening is one of the most complex phenomena in food biochemistry. It is about the breakdown of proteins, lipids and carbohydrates which could release flavor compounds and modify cheese texture (Zaharia and Gabriela 2011). The kinetics of amino acids in cheese during ripening is of particular interest because of their significance as quantitative indicators of photolytic activity during the ripening process (Buruiana and Zeydan 1982). Cheese making in Sudan is the major preservation method for surplus milk in rural areas especially during the rainy season when plenty of milk is available (El Owni and Hamid 2008). In Sudan, most popular cheese types are white soft cheese locally known as Muddaffara. The popularity of braided cheese is not only in Sudan but also in many Middle Eastern countries where the production and consumption of this type of cheese is relatively high. It is a semi hard cheese with hard texture, yellowish color, and slightly acid and salt taste (El-Sheiken, 1997). About 7500 tons of braided cheese is manufactured in Sudan each year and sold in the local markets (FAO, 2003).

2.1.1 Braided cheese manufacture

Braided cheese was manufactured according to Altahir et al, (2014). Briefly, the obtained fresh cow milk (10 kg) was divided in two equal portions. One was used as raw milk without pasteurization and the other was pasteurized. Both milk were warmed to 40℃, and then starter culture with a combination of 1:1 *lactobacillus bulgaricus* and *Streptococcus thermophiles* (0.02%), rennet (0.5g\5kg milk) and Na Cl were added to both milks. After complete coagulation (about 45 min), the curd was cut or broken to small parts and incubated until the required acidity (0.49-0.67 lactic acid %) for

kneading was reached. The curd was put on a wooden table, and left for (5 min) to drain off the remaining whey. The curd was then cooked in 500 ml of whey at 70-80℃ for five minutes. A natural flavoring ingredient such as black cumin was added (0.5%) to the hot paste, then cut into small pieces and flattened, like a circle shape. The curds formed where then braided, divided into three equal portions, each packed in plastic container assigned randomly to one of the three salted whey(0%, 5%, and 10% salt) in a ratio of 1:1(cheese: whey) and stored for up to 90 days at 5±2℃.

2.2 Whey:

Whey is a by-product obtained from cheese manufacture depending on the type of casein coagulation, whey can be sweet or acid composition and properties of whey mainly depend on the technology of cheese manufacture and on the quality of milk used for cheese production (Tratnik, 1998). Dairies and cheese factories produce terrific quantities of whey in which about 90% of them pelts into the sewerage system without making and useful of them. The content can be separated and extracted in order to be added as a nutrient environment food industry (Jakuble, 1977). Whey, by definition from 21 U.S code of federal regulations (CFR) $184.1979a, is the liquid substance obtained by separating the coagulum from the milk or cream in cheese making. The milk is often standardized before cheese making in order to optimize the protein (casein) to fat ratio (Farrell *et al.*, 2004).

2.2.1 Composition of the whey:

There is approximately 3.6% protein in liquid bovine milk. This protein fraction is composed of 20% whey and 80% casein. Whey is the liquid substance obtained by separating the coagulum from milk or cream in cheese making (Madureira *et al.*, 2007). In its raw liquid from, whey is composed of naturally occurring macronutrients-i.e.,(water 93%) protein (0.8%) ,(fat 0.3%) ,lactose(4.8%) and minerals-referred to as ash(0.5%).Whey is the

collection of globular proteins isolated from the liquid fraction (micronutrients) that are biologically active-β-lactoglobulin, alpha-lacatbumin, glycomacropeptide, bovine serum albumin, immunoglobulin's, lactoferrine and lactoperoxidase (Madureira *et al.,* 2007).This is accomplished by adding protein solids (i.e., condensed skim milk and non-fat dry milk (NFDM) to the standardized cheese milk (SCM) in order to improve cheese (compositional) quality and production yields. Rennet (animal-derived) or chymosin preparation (fermentation-derived) 21CFR 184.1685 calcium chloride (21 CFR184.1193) and dairy cultures are added to the SCM. These nonorganic substances are allowed as ingredients in or processed products labeled as organic (Kank *et al.,* 2010).The casein coagulates in the presence of rennet or (lactic) Acid to from the cheese curd. The pH of the cheese milk drops from 6.7 to 5.3 which causes the casein protein to coagulate and from a curd. The curd traps most of the lactose, fat, and ash. The liquid whey protein that remains is further processed into a variety of commercial ingredients from dried whey (13 percent protein) to whey protein concentrates (25 to 89 percent protein) and whey protein isolates (greater than 90 percent protein).

One pound of cheese produces nine pounds of liquid whey protein. In high moisture fresh cheese such as cottage cheese (where a portion of the original raw milk is returned to the cheese as cream dressing) the ratio may be as low as 6:1(Brown, 2014; Burrington, 2012; Etzel, 2004 and Wastrel, 1999). According to its average composition whey is approximately 93% water contains about 50% total solids present in the milk of which lactose is the main constituent whey proteins constitute less than 1% of dry matter (Beucler *et al.,* 2005). Minerals and milk fat are also present but in amount, however whey protein composition is very variable and significantly depends on the technology of whey production. However, in processes of traditional cheese manufacture, regardless of casein coagulation process, almost all whey proteins cross into the whey due to their insensitivity to enzyme activity and

acids (Tratnik, 1998). Thereat whey proteins are the constituents which put whey into spotlight on the diary products market.

Lactose is the main constituent (about 70%) of the whey dry matter and is a very important source of energy, but it has several roles. Some of beneficial effects of lactose are stimulation of peristaltic activities in the digestive tract, alleviation of calcium and phosphor absorption, establishment of lightly acid reaction in the gut which inhibits the growth and expansion of pathogens .Furthermore, lactose also assures the optimal amount of magnesium and improves digestion of milk fat and other nutrients in human organism and it does not participate in plaque formation. Heat treatments of whey cause transformation of certain amount of lactose into lactulose which is bifidobacteria growth promoter (Tratnik, 2003).

Water soluble vitamins present in the milk also pass into the whey, but their amounts are very variable and highly dependent on the storage conditions of whey. Thereby riboflavin, folic acid and cobalamine are present in significant amounts. The latter ones are bounded to whey proteins and mostly remain in whey after cheese manufacture. It is interesting that they can contain higher amounts of riboflavin than milk, due to the activity of some lactic acid bacteria used in cheese manufacture. Due to relatively high content of riboflavin, whey has a characteristic yellow-green color (Popvic-Vranjes and Vujicic, 1997; Tratnik, 1998).

Mineral composition in whey dry matter is the variable (7-12%) and depends on the technological process of cheese production (Popvic-Vranjes and Vujicic, 1997).

Whey contains almost all soluble salt and microelements present in the milk, but also salts added in the cheese manufacture process thereby calcium and phosphates are partially remaining bounded in the case in contained in

cheese, and their contents are much higher in acid whey because of much higher solubility in acid medium (Tratnik, 1998).

2.1.2 Benefits of whey:

It facilitates the digestion of food and treats constipation, improves the secretion of enzymes and hormones in the body, a natural muscle tonic, which makes it an ideal choice for bodybuilders, strengthens the immune system and increases the rate of fat burning in the body, protects against high blood pressure and reduces high blood pressure cholesterol in the blood, is useful for diabetics because it controls the level of sugar in the blood (Zemel, 2003).

2.3 Whey proteins:

The major proteins in whey are β- lactooglobulin (β-lg), lactlbumin (La), bovine serum albumin (BSA), and immunoglobulin (lg). Whey contains low concentration of other proteins such as lactoferrin, and enzyme such as lysozyme, lipase and xanthine oxidase. The most abundant whey proteins are B-lg which represents about 50% of the total whey proteins in bovine milk .B-lg plays a key role in any processing operation (Swaisgood, 1982). α-lactalbumin is the second most important whey protein and represents about 20% of the serum protein in bovine milk. This protein is the a co-enzyme, which plays a role in the final 23 stage of lactose synthesis (Sienkiwicz and Riedel 1990).A total of 123 amino acids are present in the primary structure of this protein which has a molecular weight of 14,000 Daltons and four disulfide bonds. Bound calcium stabilizes the molecule against irreversible thermal denaturation (Hiraoka and Sugai 1984).Removal of the calcium leads of the reduction of transition temperature and thermal denaturation and aggregation (Kronman *et al*., 1981).

Whey protein can interact without heating, with various non-dairy components including pectin, tannins and polyols (Rawel et al., 2001).

Whey protein is used in a variety of foods, including ice cream, bread, and infant formula. It has also been used to replace fat in a number of products. With its high protein quality score and branched chain amino acid (BCAA) content, whey protein has also long been popular in the exercise industry as a muscle-building supplement.

2.4 Ghee

Ghee is regarded the Indian version of clarified butterfat, mostly produced from cow milk, buffalo milk, or mixed milk (Sserunjo *et al.*, 1998; Rajorhia, 1993). Its origin dates back to prehistoric Indian civilization as far as 1500 BC. In some Middle Eastern countries similar kinds of products are use-ally made from goat, sheep, or camel milk and are commonly known as maslee or samn. In Iran, ghee is called rogham (Urbach & Gordon, 1994).Ghee is specified as containing a minimum 99.6% milk fat and 0.4% free fatty acid with no more than 0.1% moisture(Codex Alimentarius, 2006).

2.4.1 Composition of ghee:

The composition of ghee based on cow milk. Proximate compositions of ghee are fat 99%, protein 0.3%, and water 0.3%. Saturated fatty acids (57.5 g per 100 g) are the major component of fat in ghee. Predominant saturated fatty acids include palmitic, stearic, and my ristic acid. The concentrations of these fatty acids are higher than found in butter. However, SCFAs in ghee, such as butyric, caproic, caprylic, and capric acid, are in lower concentrations than in butter. This gives ghee a longer storage life than butter with less rancid off-flavor. These fatty acids are potentially beneficial for reducing body weight and body fat. Further, these fatty acids are easily digestible and transferred directly from the intestine to the portal circulation and are a preferred source of energy (B-oxidation). Higher concentrations of monounsaturated and polyunsaturated fatty acid are found in ghee, and these have various biological benefits (USDA, 2010).

2.4.2 Amino acids, minerals, and vitamins in ghee.

The total amino acid concentrations are a little lower in ghee than in butter. Minerals are relatively low in ghee. Fat-soluble vitamins, such as vitamin A, carotene, and vitamins K, are found in similar concentrations to those in butter. The heating process of ghee causes certain losses in vitamins, and in particular water soluble - vitamins are negligible in ghee (USDA, 2010).

2.4.3 The major use of ghee:

Is in frying and dressing foods, and it is considered a sacred article in some religion rites (Rajorhia, 1993). Ghee in pure from is used to feed children because of its therapeutic value, and is mixed with honey and used as an aphrodisiac. Ghee is considered to be fairly stable due to the low water content and high antioxidant properties. Ghee is also rich in CLA, which shows anti-carcinogenic effects (Sserunjoge *et al*., 1998).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials:

Braided cheese whey was collected from a factory from AL- Bagir in AL Jazeera State.

3.2. Methods:

3.2.1 Chemical composition:

The chemical composition (moisture, fat, protein and ash) of whey was analyzed as follow:

3.2.1.1 Moisture of content:

Determined according to the AOAC (2000).Two grams of sample were dried in an oven at 103℃ for three hours the test repeated three times then the average was taken.

$$\textbf{Moisture content} = \frac{\textbf{weight of loss(gm)}}{\textbf{weight of sample}} \times 100$$

3.2.1.2 Fat content:

Fat content determined by gerber method according to Bradley et al., (1992). Ten ml of sulphuric acid 10 ± 0.2 ml were measured into Gerber butyometer, and then the sample was withdrawn using a pipette (11.07) that allowed draining slowly to prevent a violent reaction with the acid. Then one ml of amyl alcohol was added, the lock stopper was inserted securely and the butyrometer was shaken until the curd was completely digested. The butyro meters were placed in a water bath at 60-63℃ for at least five minutes. The straight line at the bottom of the fat column was gently pushed upward to the

nearest whole percent graduation mark. The fat content was then recorded as the difference between the lower and upper readings.

3.2.1.3 Protein content:

Nitrogen content determination were made in fat free meals by Kjeldal technique following the AOAC(2000).About 2 gm of sample was weighted accurately into Kjeldal flask, 4 gm of catalyst mixture and 35 ml of concentrated sulphuric acid were added, the flask was placed in the digestion equipment for 24 hours. The digested sample was then placed in the distillation apparatus 20ml of 40% Na OH were added and the ammonia evolved was received in 8ml of 2% boric acid solution. The trapped ammonia was titrated against 0.02N\HCL using universal indicator Methy red+ bromocresol green)

$$N = \frac{\text{Volume of HCL} \times 0.02N\backslash HCL \times 14}{\text{Weight of sample}} \times 100$$

3.2.1.4 Ash content:

Ash content was determined according to the AOAC (2000). Two g of sample was ignited at 550℃ in a muffle furnace for 3 hours.

$$\text{Ash content\%} = \text{Weight of ash}\backslash \text{ Weight of sample} \times 100$$

3.2.2 Lactose content of whey:

Lactose content determined according to the AOAC (2000). Ten ml of filings solution B 25 ml of the sample were added into the conical flask containing solutions A and B then the conical flask was heated until boiled then three drops of methylene blue indicator were added.

Then lactose solution was added to the boiling solution drop wise at intervals of ten seconds until the blue color of the methylene blue indicator disappeared. Then the volume of lactose used at the end point of the reaction was recorded.

Lactose% = ((x-y) × 0.05)\ 2.5

X = volume of lactose of blank sample

Y = volume of lactose of sample

3.2.3 pH of whey:

The pH of the whey was determined using a digital PH meter at 25℃.

3.2.4. Preparation of ghee:

The method of the production of butter has been used in this research as follow: The cream was collected on the surface of the sauce, and then it was placed in a bowl over a low heat and stirred with a wooden spoon to avoid the butter burning for an hour. After one hour, signs of ripening of the ghee began to appear with severe such as frothy and the characteristic smell of ghee. However, in this study, 12 Kg of whey cream was inserted into a separator until 4Kg of butter is formed. This butter was heated at a temperature 37-39℃, and then about 1800 gm of ghee was formed.

3.2.5 Peroxide value of ghee:

The Peroxide value of the ghee was determined according to AOAC (2005) methods.

3.2.6 Physical properties if ghee

While the density, viscosity were determined according to Dardiri (1985).

CHPTER FOUR

RESULTS AND DISCUSSION

4.1. Chemical composition of whey, butter and ghee:

Table (4.1) shows the results of chemical composition for whey, butter and ghee. The results for whey were 93.7, 0.86, 0.61, 0.48 and 4.35 % for moisture, proteins, fats, ash, and lactose contents, respectively. These results were similar to those reveled by Sarala prajapati (2012) (93.02, 0.9, 0.5, 0.42, 4.50 %).

The results of chemical composition of butter were 46.47, 8.41, 33.13, 3.51 and 8.48 % for moisture, proteins, fats, ash, and lactose content, respectively. These results were disagreed with the findings reported in Dairy Technology (2014) which were (80.3, 3.0, 11.5, 0.7, and 4.3%). Theses variations might be due to animal genotype, animal's nutrition and health status and environmental conditions.

The results of chemical composition of ghee were 0.45, 2.11, 91.97, 0.37 and 5.10% for moisture, proteins, fats and ash contents, respectively. These results were differed from that established by (food science and technology (2020) which were (0.30, 0.81, 98.8 and 0.09%). so these variations might be due to animal genotype, animal's nutrition and health status and environmental conditions.

Table 4.1: Chemical composition of whey and Butter, Ghee:

Sample	Moisture%	Ash%	Protein%	Fat%	Lactose%
Whey	$93.7^{a} \pm .48$	$0.48^{b} \pm 0.14$	$0.86^{a} \pm 0.28$	$o.61^{a} \pm 0.12$	$4.35^{c} \pm 0.05$
Butter	$46.47^{b} \pm 0.72$	$3.51^{a} \pm 0.15$	$8.41^{b} \pm 0.12$	$33.13^{b} \pm 0.23$	$8.48^{a} \pm 0.28$
Ghee	$0.45^{c} \pm 0.29$	$0.37^{b} \pm 0.04$	$2.11^{a} \pm 1.44$	$91.97^{a} \pm 2.57$	$5.10^{b} \pm 0.06$
Cv%	3.13	8.68	3.20	5.23	4.44
SE±	1.16	0.10	0.68	1.25	0.19
LSD	2.86^{*}	0.25^{*}	1.68^{*}	3.05^{*}	0.47^{*}

Values are the means ±sstandard deviation. Means in same column with different superscript letters are significantly different.

4.2 Physicochemical properties of Whey, Butter and Ghee

Table 4.2 represents the physicochemical properties of whey, butter and ghee. The result for acidity of ghee was lower than that of whey and butter and same (0.46) as those that reported by Rodia, (2016).The result for pH of butter was lower than that of whey and ghee because rennet enzyme during manufacture of cheese and production of short chain fatty acids (lactic acid, acetic acid) by the bacteria during fermentation.

4.3. Peroxide value, viscosity and color of Ghee:

The result of peroxide value analyses of ghee were shown on table (4.3). Peroxide value of ghee was (2.47Mg\Kg)in same range with that reported by Okullo, (2010). The results for color and viscosity in same range with that reported by Rodia,(2016).

4.4 Sensory evaluation of ghee:

Table 4.4 shows the results of the sensory evaluation of the ghee. The results revealed there was no significant difference in texture, color and overall acceptability between the ghee produced and control, but there was significant difference ($p < 0.05$) in flavor.

Table 4.2: pH, Acidity and Density of Whey, Butter and Ghee:

Sample	pH	Acidity	Density
Whey	$5.67^{b} \pm 0.36$	$0.51^{b} \pm 0.14$	$1.3017^{a} \pm 0.015$
Butter	$4.87^{c} \pm 0.2$	$1.35^{b} \pm 0.07$	$1.064^{b} \pm 0.018$
Ghee	$6.23^{a} \pm 0.12$	$0.46^{a} \pm 0.01$	$0.911^{c} \pm 0.0006$
CV%	4.56	12.40	1.3
SE±	0.20	0.07	0.011
LSD0.05	0.50^{*}	0.19^{*}	0.028

Values are the means ±sstandard deviation. Means in same column with different superscript letters are significantly different.

Table 4.3: Peroxide value, viscosity and color of Ghee:

Peroxide value	2.47Mg\Kg
Viscosity	39.29 ± 0.818
Color	37± 1.37

Values are the means ±sstandard deviation.

Table 4.4: Sensory evaluation of ghee:

Sample	Color	Flavour	Texture	Taste	Overall
A	$4.5^{a} \pm 0.89$	$4.75^{a} \pm 0.44$	$4.25^{a} \pm 0.77$	4.25 ± 0.85	2.0 ± 0.0
B	$4.0^{a} \pm 0.81$	$4.12^{b} \pm 1.08$	3.81 ± 0.65	4.18 ± 0.91	1.8 ± 0.4
Cv%	20.15	18.74	17.79	20.95	14.95
SE±	0.3	0.29	0.25	0.31	0.1
LSD	0.61^{NS}	0.6^{*}	0.51^{NS}	0.2^{NS}	0.6^{NS}

Values are the means ±sstandard deviation. Means in same column with different superscript letters are significantly different.

A= Sample experiment

B= control

CV=Coefficient of Variation

SE= Standard Error

LSD= Least significant Difference

AND:

1= Unacceptable.

2= Acceptable.

3= Good.

4= Very good.

5= Excellent.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

The research was carried out to assess the chemical and physical characteristics of ghee sample to obtained from whey it was concluded the ghee high fat (91.97), the physicochemical properties are similar.

There is no significant difference between ghee made from milk and ghee made from whey.

5.2. Recommendations:

- Paying attention to cheese production waste such as whey, and using it in some industry and extracting all food materials that contain it, such as whey proteins.
- Pay more attention to the product and use modern methods to reduce moisture and peroxide to make it conform to specifications and standards.

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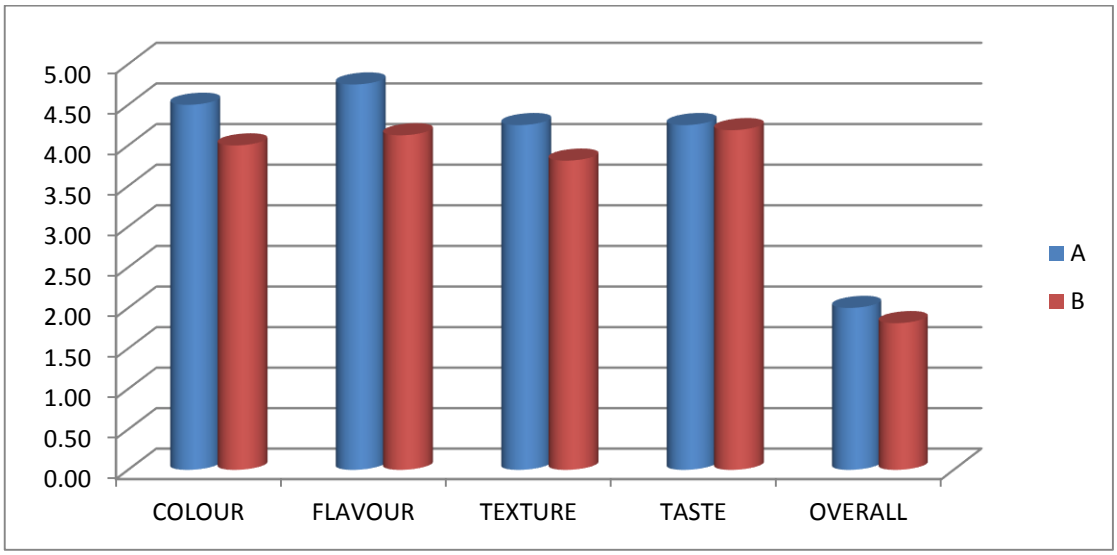
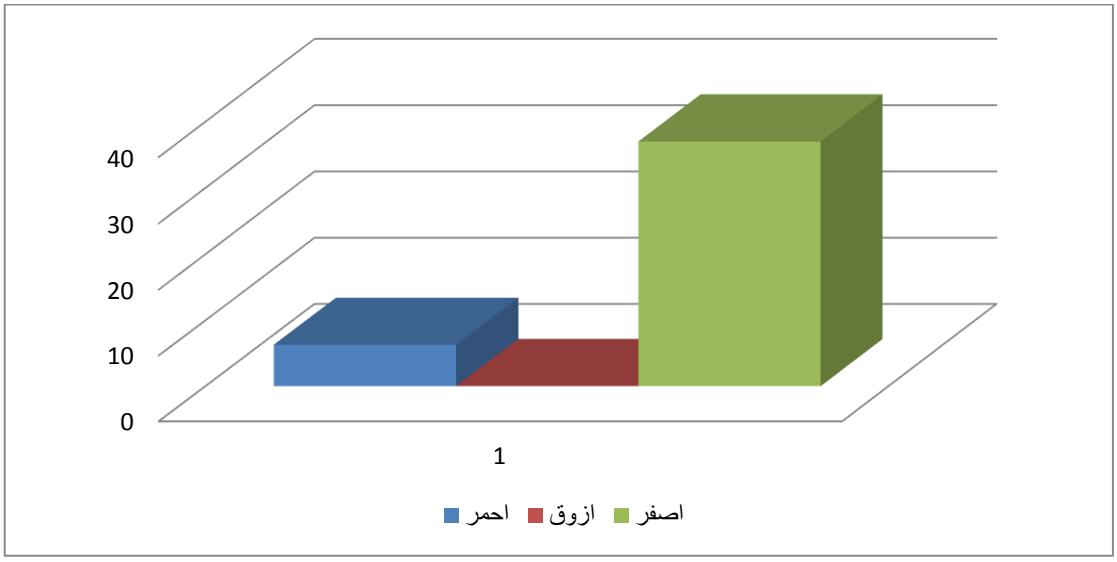
APPENDICES



Appendices 1: Sensory Evaluation of Ghee and control



Appendices 2: Color of ghee