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Effect of dryer & drying methods on quality and nutritional value of dried sweet and sour whey produced from white Cheese

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Abstract

Objectives of this work were directed towards the study of suitability of Sudanese liquid bovine whey for production of whey powder and to establish the effects of different drying methods on products qualities and nutritional value stability. The drying operation includes concentration and dehydration of liquid whey. Different types of whey were used (sweet and sour whey) and different techniques were used (spray dryer and traditional methods). The drying techniques and type of whey affect chemical composition of sweet and sour whey powder(WP) , the dry sweet samples produced by traditional methods had higher values in moisture, fat and protein content. The drying techniques and types of whey affect physiochemical properties of sweet and sour WP, the sweet WP produces by both types of drying methods were higher in pH and TSS however acid WP produces by both types of drying methods were higher in acidity than that sweet WP. Generally acid whey produces by both types of drying methods were higher in mineral content. The drying techniques and types of whey affect nutritional value of WP, the sweet WP produces by spry dryer were found to be higher in calories 384.05 Kcal.

Keyword: Cow's milk- white cheese-Drying –sweet whey - sour whey - dried whey.

المستخلص:

تهدف هذه الدراسة الى دراسة مدى ملائمة شرش لبن البقر السوداني لإنتاج مسحوق الشرش وتحديد تأثيرتقنيات التجفيف المختلفة علىالقيمهالغذائيه للمنتجات المجففه. تتضمن عملية التجفيف تركيز وتجفيف مصل (الشرش) اللبن السائل. تم استخدام أنواع مختلفة من الشرش (الحلو والحامض) تم استخدام تقنيات مختلفة (مجفف الرذاذ والطرق التقليدية). تم دراسة هذه العمليات وتأثيرها على كفاءة العملية ونوعية المنتج. تؤثر تقنيات التجفيف ونوع الشرش على التركيب الكيميائي لمسحوق الشرش الحلو والحامض، حيث كان للعينات الحلوة الجافة المنتجة بالطرق التقليدية قيم أعلى في محتوى الرطوبة والدهون والبروتين. كماأثرت تقنيات التجفيف ونوع الشرش على الخصائص الفيزيوكيميائية ، حيث كان مسحوق الشرش المنتج عن طريق كلا النوعين من طرق التجفيف أعلى في الأس الهيدروجيني و المواد الصلبة الذائبة، إلا أن مسحوق الشرش الحامضي الذي ينتج عن طريق كلا النوعين من طرق التجفيف كان أعلى في الحموضة من مسحوق الشرشالحلو,بشكل عام مسحوق الشرش الحامضي الناتج عن كلا النوعين من طرق التجفيف كان أعلى في المحتوى المعدني. تؤثر تقنيات التجفيف ونوع الشرش على القيمة الغذائية لمسحوق الشرش، وقد وجد أن مسحوق الشرش الحلو الذي ينتجه مجفف الرزاز أعلى في السعرات الحرارية 384.05 سعرة حرارية.

الكلمات المفتاحية: لبن البقر– الجبن الأبيض –التجفيف – الشرش الحلو – الشرش الحامضي – الشرش المجفف.

Introduction

Milk is the only food designed for mammals by nature through evolution. Mammals have adapted to consume all other foods. Milk provides nutrition in the form of energy from the carbohydrate present in the form of lactose, nitrogen from the protein content and a rich source of calcium to build bones to name but a few. Milk also provides other important benefits. For example, there are many biologically activities associated with certain components in milk. Almost without exception, these biologically active components are exclusively to be found in the whey or serum fraction of milk. Whey is the watery and thin liquid, which is received during cheese making by coagulating and separating casein proteins from milk. In the case of sweet whey rennet type enzymes are used at a min pH of 5,6 to induce coagulum and in the case of acid whey coagulum is created when milk is acidified by lactobacillus culture or mineral acid at a max pH of 5.1 Whey's composition and sensory characteristics vary depending on the kind of the whey (acid or sweet), the source of the milk (cow, sheep, bovine milk etc.) and the feed of the animal which produced the milk, the cheese processing used, the time of the year and the stage of lactation {1}.Whey is the by-product of cheese or casein production, and it is of relative importance in the dairy industry due to the large volumes produced and its nutritional composition. Worldwide whey production is estimated at approximately 185×10^6 tons/year; of this amount, only 92.5×10^6 tons/year is processed, accounting for 50% that is treated and transformed into various foods and feed products. Approximately half of this is used directly in liquid form, 30% as powdered cheese whey, 15% as lactose and it's by products, and the remaining is used as cheese whey-protein concentrates {2}.Cheese whey is a yellowish liquid remaining after milk coagulates during cheese production. It is a by-product of the manufacture of cheese and has several commercial uses. Cheese whey is produced in huge amounts and is a significant environmental problem due to the high levels of organic matter content. Cheese whey represents a biochemical oxygen demand (BOD = 230mg/mL) and a chemical oxygen demand (COD = 70mg/mL). Lactose is largely responsible for the high BOD and COD, since protein recovery reduces only about 12% of the whey COD. On the other hand, whey retains much of the milk nutrients, including functional proteins and peptides, lipids, lactose, minerals and vitamins and therefore has a vast potential as a source of added value compounds, challenging the industry to face whey surplus as a resource {3}.Whey may be defined broadly as the serum or watery part of milk remaining after separation of the curd, which results from the coagulation of milk proteins by acid or proteolytic enzymes. The type and composition of whey at dairy plants mainly depends upon the processing techniques used for casein removal from liquid milk. In addition the dairy industry suffers from an economic blow due to several treatment costs that are incurred in proper disposal of whey. Although several possibilities of cheese whey utilization have been explored, a major portion of the world cheese whey production is discarded as effluent. Its disposal as waste poses serious pollution problems for the surrounding environment {4}.

Justification of this study

Large amounts of wastewaters emerge from milk processing in dairies, which are one of the largest sources of industrial effluents. Thus, wastewater and organic residues produced from dairy production have the potential to be converted into economic gain if the proper processing technology is employed. The worldwide production of whey is greater portion remains unutilized, which causes an environmental pollution. An estimated 41 billion kilograms of whey was generated as a byproduct of cheese production in 2006 {5}.The world's production of cheese whey is much in year yielding an important source of environmental pollution. For years, the disposal of liquid whey was problematic and often discharged into local waterways, ocean/seas and fields, or was used in animal feed. Discharging whey into lakes and rivers removed the economic burden of disposing of whey in waste treatment facilities. However, as the whey contains organic substances, oxygen is required for the decomposition and dumping of whey will therefore have a great influence on the environment. In terms of volume and weight, whey is in fact the largest amount of material resulting from the production of cheese. Instead of processing the whey in special plants some dairies have disposed large quantities of whey by spraying it over the fields, which is a non effective method giving benefit both to the factory and to the farmer.Whey powder is a complex ingredient made up of protein, lactose, fat and minerals,{6}. This means that the keeping quality of the whey is prolonged, the solids content of the dried product is constant and seasonal variations in the supply are avoided. It has therefore been necessary to find alternative types of products made from whey that would be more attractive for consumers, together with alternative low-cost technologies that would be more attractive for producers.Consequently the factories are very often taking advantage of drying the whey thus transforming it into a powder {7}.

Problem statement

Dairy waste discharged by milk processing industry in Sudan under uncontrolled and unsuitable conditions is causing significant environmental problems. The importance of dairy wastewater treatment is undoubtedly the key factor to bring sustainable development and clear environment to the society. However, since this company has discharged the waste whey into water bodies and local environment without any treatment, it has a serious impact on natural water bodies, public health, and environment and soil because the societies around that factory daily use this water and children are highly got diseases. It also affects aesthetic merit, nuisance, and transparency because milk processing industry was found in city and affects human health. Therefore, cheese whey is the main byproduct of the dairy which is produced in large quantities and usually causing major environmental pollution due to its high organic load. Cheese whey discharged from milk processing industries is highly contaminated with organic compounds such as chemical oxygen demand (COD = 70 mg/mL) and biological oxygen demand (BOD = 230 mg/mL) which severely affect the environment, soil and water bodies. The whey contains protein, nutrient and carbohydrate that affect the water bodies through many processes. It reduces dissolved oxygen of water and soil and thereby, affects aquatic life.The chesses industry in Sudan was largely found in rural areas (White Nile locality) and released whey to the environment without any treatment. This cause soil pollution and thereby, affects farmer’s agricultural production because whey is a constituent of nutrients and acids. This changes the soil properties and fertility. In addition, it affects animal feeding such as grass and changes its contents. Generally it has an effect on economic destruction and losses of soil fertility. In other hand, there is high cost to treat waste whey in Sudan. It is important to convert this dairy waste into powder to fortify some meal our country.

Objective of this study

The general objective of this study was to characterize dairy cheese whey and to determine suitable drying process.

Specific objectives

to characterize physiochemical parameters for both type of dairy cheese whey (sweet and sour), to determine the suitable drying process to manufacturing whey powder and to increase the awareness to the efficient use of the underutilized Sudanese local cheese whey powder.

Materials and Methods

Food materials

The Sudanese whey was obtain from cheese (white cheese) manufacture, and was prepared inFabi Factory, Khartoum North. The sweet whey was obtained from enzymatic curdling of milk by rennet enzyme during traditional cheese manufacture, acid whey was obtain from cheese manufacture by acidification of milk by addition of lactic acid, experiments were done in Industrial Research and Consultancy Center.

Experimental methods

Cheese manufacture

Twenty liters of milk were heated to 65°C for 30 min, cooled to 35° C, and then salted, 2% (w/w) of sodium chloride were added to the whole milk. The milk was then divided into two batches of 10 Liter each. The first batch was curdling with Rennet tablet and the second batch curdling with acidity (lactic acid bacteria). The first batch rennet tablet was dissolved in 20-ml distilled water and the solution was hand stirred for five min using a spoon. The batch was then incubated at 40°C and left to develop a curd. After coagulation the curd was cut with an ordinary stainless steel knife to allow for whey separation.The curd was poured into small wooden molds lined with cheesecloth, pressed and left over night. The second batch starter culture were dissolved in 100 ml of milk, incubated for 2 hours at 37 °C, then adding to the whole milk, the batch was then incubated at 37°C and left to develop a curd. After coagulation the curd was cut with an ordinary stainless steel knife to allow for whey separation. The curd was poured into small wooden molds lined with cheesecloth, pressed and left over night.

Whey dehydration

Spray Drying Method

1st step: Accurately weighed 10 Ib of liquid whey samples were concentrated by using rotary evaporator, and continues evaporated about 2 – 3 hr until the total solids reached 30 – 50 %. This step is important to avoid over – heating, **2nd step:** The concentrated whey samples were transferred to spray drier model Anhydro, Type lab S1, the drying conditions were 180° C, a flow rate of 20 ml/min and a pressure of 1.5 bars. Immediately the dried whey samples were transferred from spray dryer, cooled, weighed and packaged in stain less steel containers.

Traditional methods

Use to dry the whey incubation heat shield 55º C for 48 hours, after freezing the whey in a refrigerator temperature below 5º Celsius and separate the water in a water bath temperature of 48º C and filtered with a filter put the solid material in aluminum foil and then placed in incubators, refilled ,Crushed , packaged and storage. Drying time 2-3 days, Production efficiency every 2 liters given 150 grams.

Whey powder examination

Determination of whey powder chemical component

On the dry base whey powder chemical component were determined according to the method of {8}.

Determination of whey powder physiochemical prosperities

On the dry base whey powder physiochemical prosperities were determined according to the method of {8}**.**

Determination nutritional value of whey powder

The average nutritional value of protein, carbohydrate, fat and lactose were determined from the proximate analysis results and expressed as g/100 ml whey powder.For energy calculation the established and accepted data for energy factors per gram of the Royal Society of Chemistry / Ministry of Agriculture, Fisheries and Food – UK. (1998).

Determination of whey powder minerals content

On the dry base whey powder minerals content (sodium, calcium and potassium) were determined according to the method of {8}.

Energy factor per gram

Component	Kilocalories Kcal	Kilojoules kJ
Carbohydrate	4	17
Protein	4	17
Fat	9	37
Ethanol	7	29
Organic acid	3	13

Source :RoyalSociety of Chemistry / Ministry of Agriculture, Fisheries and Food – UK. (1998)

Statistical analyses

Replicate of each sample was analyzed using statistical system, the analysis of variance was performed to examine the significant effect in all parameters, Least Significant Difference test (LSD test), was used to separate the means {9}.

Result and Discussion

Influences of specific factors on the quality attribute of sweet and sour whey powder (WP)

Since each steps of processing e.g. preparation and evaporation, affect the quality prosperities of the final product (WP), experiment work needed to investigate the effect of each of these steps separately.

Effect of drying techniques on chemical component of sweet and sour whey powder (WP)

The effect of evaporation techniques on chemical component of WP (sweet and sour whey powder) on dry base used in these study shown in Table 1. Moisture content of WP produces by different techniques was significantly different ($P \geq 0.05$), obviously the water content of WP is away higher to the raw whey, this because evaporated water by evaporation techniques (Spray dryer, Traditional dryer). Dry sweet WP dryed be traditional methods was recorded high Moisture content (3.00%) than those obtained by spray methods (sweet and sour) and sweet whey produces by traditional methods 2.47, 1.95 and 2.54% respectively. these results may be due to the effect of high heat air in spray dryer devices, these results are similar to the results of {10} who reported that It was reported that the heat efficiency of spray dryer is about 25% to 60%.Fat content of WP produces by different techniques were non significantly different (P≥ 0.05), the dry sweet WP produces by spray and traditional methods were higher 1.75 – 1.71% respectively, than dry sour WP produces by both methods 1.50 -1.49% respectively. The fat content of whey varies depending on process parameters such as the strength of the coagulum at cutting, the curd-cutting mechanism (manual vs. mechanical), the size of the curd, and time allowed for skin formation on curd particles{11}.

Protein content of WP produces by different techniques was significantly different (P≥ 0.05). It clear that the dry sweet WP produces by spry and traditional methods were significantly (P≥ 0.05) higher 45.94 - 44.63 % respectively, than dry sour WP produces by both methods 43.72 - 42.48 % respectively. These results maybe due to fact that sour whey free from milk protein (casein), because of acidity more efficient in precipitation of casein than enzyme (rennin) in sweet whey, these results in the same line with results of {12} who reported that the rennet coagulation involves cleavage of κ-casein, and the resulting protein residues formed are present in rennet whey (sweet whey).Ash content of WP produces by different techniques was significantly different (P≥ 0.05), the WP produces from sour whey by both techniques (spray and traditional) 4.25 - 4.35% respectively, were significantly (P≥ 0.05) higher than sweet WP produces by the same methods 3.33 - 2.69 % respectively, these may be due to sour whey rich in minerals, these results agree with results of {12} who stated that acid whey contains a much higher concentration of calcium, magnesium, phosphate, and citrate than sweet whey or milk serum owing to the solution of the colloidal milk salts upon acidification, and comparable with {13} who mention that the while the higher mineral level is due to more of the calcium being solubilized by acidification.Also lactose content of WP produces by different techniques was significantly different (P≥ 0.05), the WP produces from sweet whey by both techniques (spray and traditional) 46.00 -43.97 % respectively, were significantly (P≥ 0.05) higher than sour WP produces by the same methods 41.63 - 43.27 % respectively, these may be due to convert of lactose to lactic acid during the curd formation process.

Table (1) : Effect of drying techniques on Chemical composition of sweet and sour whey powder (WP)

	Methods of drying				Overall mean of drying methods	CV	Lsd0.05	S.E. ±
	Spray		Traditional					
	Dry sweet	Dry Sour	Dry sweet	Dry sour				
Moisture	2.47^{b} ±0.158	1.95^{c} ±0.141	3.00^{a} ±0.424	2.54^{b} ±0.148	2.50	29.7546	0.37493	0.0712
Fat	1.71^{a} ±0.252	1.50^{a} ±0.332	1.75^{a} ±0.070	1.49^{a} ±0.322	1.61	17.3449	1.6745	0.0506
Protein	45.94^{a} ±0.396	44.63^{a} ±1.523	43.72^{b} ±1.395	42.48^{b} ±0.723	44.20	7.54636	1.69138	0.3215
Ash	3.33^{b} ±0.45	4.25^{a} ±0.71	2.69^{c} ±0.29	4.35^{a} ±0.29	3.66	25.1906	0.46609	0.0885
Lactose	46.00^{a} ±0.630	43.97^{a} ±1.207	41.63^{b} ±1.577	43.27^{b} ±2.955	43.72	12.4048	2.74522	0.5218

**Mean ± SD values bearing different superscripts are significantly different (P0≥05).*

***Each value in the Table is a mean of three replicates ±S.D*

Effect of drying techniques on physiochemical prosperities of sweet and sour whey powder (WP)

The effect of drying techniques on physiochemical prosperities of WP (sweet and sour whey powder) on dry base used in these study shown in table 2.

pH value of WP produces by different techniques were non significantly different ($P \geq 0.05$), the dry sweet WP produces by spry and traditional methods were 4.23 – 4.18 respectively, than dry sour WP produces by both methods 4.23 -4.32% respectively. The pH value was not significantly ($p<0.05$) different in the all samples, but that of the sour WP is comparatively lower than the sweet

WP one, these decrease in pH due to the transformation of lactose to lactic acid. TSS of WP produces by different techniques was significantly different (P≥ 0.05), the WP produces from sour whey by both techniques (spray and traditional) 91.15 – 91.68% respectively, were significantly (P≥ 0.05) lower than sweet WP produces by the same methods 97.15 – 95.27 % respectively, This could be due to the high temperature of spray drying method compared to the sun drying {14}.Acidity of WP produces by different techniques was significantly different (P≥ 0.05), there were significantly different (P≥ 0.05) between acidity of sweet WP produces by spry dryer and the rest of the samples, it clear that the acidity of sour WP produces by both methods significantly (P≥ 0.05) higher, the acid coagulation approach results in substantially increased acidity, necessary for casein precipitation and formation of acidic cheeses. {4},reportedthat In general, whey produced from rennet-coagulated cheeses is low in acidity, while the production of fresh acid cheeses such as ricotta or cottage cheese or chhana yields medium acid or acid whey.

Table (2) : Effect of drying techniques on physiochemical prosperities of sweet and sour whey powder (WP)

	Methods of drying				Overall mean of drying methods	CV	Lsd0.05	S.E. ±
	Spray		Traditional					
	Dry sweet	Dry Sour	Dry sweet	Dry sour				
pH	4.23ª ±0.114	4.18ª ±0.025	4.23ª ±0.130	4.32ª ±0.251	4.24	0.0441	0.23227	10.821
TSS	97.15ª ±2.97	95.27ª ±1.73	91.15ᵇ ±1.42	91.68ᵇ ±0.55	93.81	5.0663	2.4060	0.4570
Acidity	0.30ᵇ ±0.45	0.44ª ±0.71	0.45ª ±0.29	0.49ª ±0.29	0.42	45.967	0.0975	0.0185

**Mean ± SD values bearing different superscripts are significantly different (P0≥05).*

***Each value in the Table is a mean of three replicates ±S.D*

Effect of dryingtechniques on mineral content (mg/100g) of sweet and sour whey powder (WP)

Table 3 show the effect of evaporation techniques on mineral content of WP (sweet and sour whey powder) on dry base.Sodium content of WP produces by different techniques was significantly different (P≥ 0.05), there were significantly different (P≥ 0.05) between sodium content of sweet samples produces by traditional methods and the rest of the samples.Calcium and potassium content of WP produces by different techniques were non significantly different (P≥ 0.05), the WP produces by spry dryer methods were higher in Calcium and potassium content than those produces by traditional methods. Calcium, potassium, sodium, and magnesium salts make up the bulk of these minerals (of >50% NaCl and KCI, calcium salts) while metals such as zinc and copper are present in negligible amounts in whey powder {15}. {16}mention that the concentration of sodium, potassium and calcium of sweet WP were 45.5, 43.0 and 36.5 mg/100g. Therefore the concentration of these mineral in the sour WP were 39.8, 58.0 and 92.8 mg/100g**.** The mineral contents of whey and whey fractions are important in their use as food ingredients and in understanding of their contribution to the nutritional quality of foods{16}. Factors that may influence the mineral content in WP are type of cheese, geographic area, stage of lactation, source of milk (breed and animal), care during storage and processing and specific operation, {17}.

Table (3) : Effect of drying techniques on mineral content (mg/100g) of sweet and sour whey powder (WP)

	Methods of drying				Overall mean of drying methods	CV	Lsd0.05	S.E. ±
	Spray		Traditional					
	Dry sweet	Dry Sour	Dry sweet	Dry sour				
Sodium	18.07[a] ±0.114	19.5[a] ±0.025	16.5[b] ±0.130	19.30[a] ±0.251	18.28	9.2633	0.8570	0.16290
Calcium	2236[a] ±2.97	2182[a] ±1.73	2170[a] ±1.42	2188[a] ±0.55	2194	8.5480	94.931	18.044
Potassium	685[a] ±0.45	606[b] ±0.71	602[b] ±0.29	623[a] ±0.29	611	11.0820	34.7629	6.60786

**Mean ± SD values bearing different superscripts are significantly different (P0≥05).*

***Each value in the Table is a mean of three replicates ±S.D*

Effect of drying techniques on nutritional value of sweet and sour whey powder (WP): Table 4 Show the composition of WP produced by different type of evaporation techniques, used in this study as main ingredient (Oil content, Protein content, lactose content, Titrable acidity).

Table 5 Show the calculation of energy content (g/100 g) of WP calculates as Royal Society of Chemistry/Mministry of Agriculture, Fisheries and Food –UK (1998). The main ingredient of WP (Fat content, Protein content, lactose content, Organic acids) and total energy as Kcal. The whey proteins have an excellent amino acid balance, including both essential and sulphur containing amino acids. These properties highlight the nutritional quality and cost-effectiveness of whey proteins. However, spray drying can cause thermal denaturation of these proteins {18}.There is significant different ($P \geq 0.05$) among the WP produced by different mean of evaporation techniques in there nutritional value (Kcal). Generally WP produces from sweet whey were significantly ($P \geq 0.05$) higher than that produces from sour whey, that probably due to concentration of lactose in sweet whey than sour whey, 184.0 - 166.52 Kcal for sweet WP produces by spry and traditional dryer and 175.88 - 173.08 Kcal for sour WP produces by spry and traditional dryer respectively.It can be observed that the WP produces by spry dryer were significantly ($P \geq 0.05$) higher in nutritional value (Kcal) than that produces by traditional methods 384.05 - 369.22 and 358.5-357.88 Kcal respectively, that may be due to low drying temperature of spry dryer techniques during drying process.

Table (4) : Nutritional composition of Whey Powder

Evaporation techniques	Type of WP	Fat Content g/100 g	Protein Content g/100 g	Lactose Content g/100 g	Titrable acidity %
Spray Dryer	Dry sweet	1.71[a] ±0.252	45.94[a] ±0.396	46.00[a] ±0.630	0.30[b] ±0.45
	Dry Sour	1.50[a] ±0.332	44.63[a] ±1.523	43.97[a] ±1.207	0.44[a] ±0.71
Traditional Dryer	Dry sweet	1.75[a] ±0.070	43.72[b] ±1.395	41.63[b] ±1.577	0.45[a] ±0.29
	Dry Sour	1.49[a] ±0.322	42.48[b] ±0.723	43.27[b] ±2.955	0.49[a] ±0.29
Overall mean of drying methods		1.61	44.20	43.72	0.42
CV		17.3449	7.54636	12.4048	45.967
Lsd0.05		1.6745	1.69138	2.74522	0.0975
S.E. ±		0.0506	0.3215	0.5218	0.0185

**Mean ± SD values bearing different superscripts are significantly different (P0≥05).*

***Each value in the Table is a mean of three replicates ±S.D*

Table (5) : Energy content per 100 ml of Whey Powder as Kcal

Evaporation techniques	**Type of WP**	**Fat Content** g/100 g	**Protein Content** g/100 g	**Lactose Content** g/100 g	**Titrable acidity** %	**Energy content as (Kcal)**
Spray Dryer	**Dry sweet**	15.39[a] ±1.46	183.76[a] ±23.96	184.0[a] ±14.302	0.90[b] ±0.56	**384.05[A] ±9.345**
	Dry Sour	13.5[a] ±2.45	178.52[a] ±33.34	175.88[a] ±12.456	1.32[a] ±0.98	**369.22[A] ±2.346**
Traditional Dryer	**Dry sweet**	15.75[a] ±2.73	174.88[b] ±34.64	166.52[b] ±14.344	1.35[a] ±0.45	**358.5[B] ±4.294**
	Dry Sour	13.41[a] ±2.24	169.92[b] ±45.45	173.08[b] ±18.565	1.47[a] ±0.98	**357.88[B] ±1.03**
Overall mean of drying methods		14.51	176.8	174.87	1.26	**367.4125**
CV		27.4943	23.44634	20.2068	34.5676	55.967
Lsd0.05		15.0705	6.76552	10.98088	0.2925	15.3333
S.E. ±		0.306	0.5265	0.3258	0.3154	0.8154

**Mean ± SD values bearing different superscripts are significantly different (P0≥05).*

***Each value in the Table is a mean of three replicates ±S.D*

Conclusions

From study on preparation of whey powder using two dehydration techniques (spry dryer and traditional methods) the following points can concluded;The majority of the cheese whey content is lactose and the remains in cheese whey constituting the 90% fraction of the organic load. Lactose is largely responsible of organic contamination that causes environmental pollutions. Therefore, it is important to manage dairy cheese whey rather than discharging it to the environment.

Dairy cheese whey powder was a byproduct that containing many essentials nutrient can reduces the malnutrition problem.

The best drying techniques were that main the physical, chemical quality properties of whey powder were the spry dryer.

Dry whey powder rich in protein and calories.

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