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Effect of Different Preservation Methods on some Physiochemical, Microbial and Sensory Properties of Doina as Fermented Cereal Dairy product

ABSTRACT

This study was conducted to synthesis of Doina the local cereal-dairy fermented product in Kurdistan region-Iraq by mixed Doo (skimmed butter milk) with fain burgul at size (1000-1500µm) produced from Muselly durum wheat, and storage for six months on Sun drying or Oven drying or freezing methods, the Doina mixture supplemented by *Lactobacillus acidophilus* and *Lactobacillus plantarium* as a probiotics, and identified by Commercial (API50 CHL) kit after six months of storage and evaluated the chemical, physical, microbial and sensory properties of final products. Significant difference ($P \leq 0.05$) between chemical composition of Doina in the different preservation methods (Sun drying, laboratory drying, Freezing) were found after storage. The rheological properties using of a sun-drying method (Traditional method) caused decreasing of gelatinization temperature in Doina mixture and it had a high amylograph maximum viscosity compared to freezing preservation method which gelatinized in high temperature and maximum viscosity in amylograph was low. There were significant differences ($P \leq 0.05$) between sensory evaluation of preserved Doina. Sun drying method had a high scores of sensory evaluation then laboratory method and freezing method.

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INTRODUCTION

Doina is one of the common fermented local Kurdish products in the Iraq Kurdistan region in the north of Iraq, it is called Kishk(Tamime., et al 1999)(Zainulabiden.,et al 2015), or chishech in other regions of Iraq, it is a traditional food in many of villages until yet, it is a ferment cereal-dairy product prepared from fain burghul and traditional buttermilk (doo), usually prepared in the last of spring, Doina is storage in length of summer then consumed in the winter, can consumption a fresh or after storage. Doina is one of the fermented food types of lactic acid fermentation as Gergoush, Kishk (Sherfi and Hamad, 2001)(Morcos., et al 1999)(Abou-Donia.,et al 1991), sun drying is the common preservation method of the doina storage. Traditional Buttermilk(doo) is a leftover liquid by-product made during the churning of the butter, it is a popular fermented drink in Kurdistan region, and in the middle east as well as in India that is named lassi (Gupta.,et al 2008).

The aim of this research defines the Doina as a traditional fermented Kurdish food and study the effect of three preservation methods as freezing and laboratory drying compared with the sun drying on the physiochemical, microbial, and sensory properties of the doina.

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MATERIALS AND METHODS

MATERIALS

Raw milk was obtained from a Bakrajow dairy cows farm (Sulaimani University College of Agricultural Engineering Science) to produce of sour buttermilk (doo) and the Mosul wheat (durum) was obtained from Sulimanya local market, Lyophilized starter culture containing *Lactobacillus delbruckii* sub sp. *bulgaricus* and *Streptococcus salivarius* sub sp. *thermophilus* (Marshall, France, Co). API 50 CHL kit (bioMerieux®, France) was used to identification of the *Lactobacillus* species, after cultivation and isolation these species on MRS media. Sodium Chloride (NaCl) trademarked Zer was used to salting of the doina product.

METHODS

Produced of Burgul:

initially, the wheat grains were cleaned, washed, soaked in water to get 40% moisture, cooked with water at 95 °C/180 minutes to get a good gelatinized starch, Sieves were used to remove the water, then dried in the laboratory temperature at (22-25)°C until the wheat grains moisture became 11-13%, then the grains were milled to size 1000-1500µm (Dalgic and Belibagli, 2008).

Preparation of sour buttermilk (doo)

Buttermilk (doo) was prepared according to (Tamime, 2009) with some modification. 30 liter of the raw milk were pasteurized at 82-83°C for 2-3 minutes. the milk ripened by adding starter culture of (*Lactobacillus delbruckii* sub sp. *bulgaricus* and *Streptococcus salivarius* sub sp. *thermophilus*) and supplemented with probiotic bacteria (*Lactobacillus acidophilus*, *Lactobacillus planetarium*), then incubated at 42-43°C for 3-4 hours to obtain approximately 1% of acidity as lactic acid, then the yoghurt was churned at 4°C, after 40 minutes the butter was removed while the buttermilk(doo) was used to produce of doina.

Produce of the Doina

Each of sour buttermilk(doo) : burgul were mixed at(3:1), the mixture was kept at 20-25 °C for one week to obtain pH 4.5 as indicator of developed acidity, two hundred fifty gram of the fresh doina were used for the analysis, while the remaining amount was formed as a circular discs, then preserved for six months by three methods which was by sun-drying for three days, artificial drying at 65 °C for 8 hours, and the third method by the freezing at -27 °C.

The chemical, Physical, and Rheological analysis

Protein, fat, ash, carbohydrate, titratable acidity, pH and moisture were analysed and determined after preparation of the doina(fresh doina) and also after storage, according to AACC methods in AACC(2008) The gelatinization temperature, viscosity break down, and maximum viscosity of Doina samples were determined by an amylograph test according to AACC(2008), 100 g of dried doina were mixed with 450ml distilled water and tested in amylograph (Brabenere Co. German) to determine gelatinization and viscosity .

The Microbiological tests and sensory evaluation

The microbial tests include total bacterial counts, total counts of yeasts and moulds, coliform, a total of *Lactobacillus*, API 50 CHL kit (bioMerieux®, France) used for identification of the *Lactobacillus* sp. While the sensory properties of the doina samples were evaluated after the storage six months, according to the 0-5 point scale all the sensory characteristics (taste, odour, mouthfeel, appearance and colour) were evaluated by the lecturers of Food Science.

Statistical Analysis

The research data were analysed with the least significant differences (0.05) and standard deviation, the data of treatments were triplicates.

RESULTS AND DISCUSSION

Chemical composition of the Doina

The chemical composition of doina before the storage as a fresh product and after six months of storage were illustrated in table 1, the protein percentage was appear (14.573) % in the fresh doina and then significantly increased ($p < 0.05$) with the methods and became (16.880), (17.425), and (17.145) % respectively storage by the sun drying, lab.drying, and freezing respectively, that mean significant differences were found between protein percentage in the fresh doina product and product at different storage treatments, from the table 1 observed that was increasing in the protein percentage in all treatments after storage compared with protein percentage of fresh doina especially in laboratory drying treatment, and that is expected with loss of moisture during storage gradually. Also significant difference was found between the sun drying treatment and the other treatments, while no significant difference observed between the laboratory and freezing treatments. Protein percentage was not a few, in generally protein percentage were mixture from wheat and milk proteins in fresh and stored doina which gave high nutritional value. The results of protein percentages of all preservation treatments were similar to Zainulabiden et al (2015) and Tamime et al (19991). Like the protein, the treatments of doina had a significant difference among them before and after storage in Ash percentage, it was (1.116)% in fresh doina then become (1.803), (1.800), and (1.610) in sun drying, lab.drying, and freezing doina respectively, no significant difference was observed between sun drying and labortary drying while the freezing treatment differed significantly from them. The fat percentage was (2.138) % in the fresh doina then became (2.425), (3.402), and (2.053) % in the sun drying, laboratory drying and freezing treatments respectively, no any significant differences were observed among the fat percentage of the fresh doina samples and others samples of treatments, but the freezing samples differed with all the treatments, the percentage of fat in the doina in all the treatments of preservation were low, that return to two factors, the first one used buttermilk for doina production which is free fat and in the other hand to protect of the doina from rancidity during storage which may be cause bad taste and off flavour, the second factor that the burgol has a low amount of fat but in another side it has a little amount of vitamin E as a natural antioxidant (Kamal Eldin and Appelqvist, 1996) in order to protect Doina from fat deterioration during the storage. A clear significant difference was observed in the carbohydrate percentage among the treatments, the carbohydrate was supported darkness colour of the doina by Maillard reaction with protein which from buttermilk sources and that desirable in the doina product, Zainulabiden et al (2015) got to same result.

All the treatments differ significantly with each other in the percentages of moisture which was (30.26) % in the fresh doina, then became 29.2% in freezing samples after six months and had not more change after this period of storage, but the moisture reduced in the samples of sun drying and laboratory drying that became (8.75) %, (8.05) %, respectively and that cause decreasing of water activity, however, some chemical reactions were continuous, these results agree with the results of Gadallah and Hassan (2019).

Table (1): Chemical composition of the Doina samples before and after preservation

Storage periods	Preservation Methods	Chemical composition%				
		Protein	Fat	Carbohydrate	Ash	moisture
One hour	Sun drying	14.573	2.138	52.083	1.116	30.255
	Lab.drying	14.573	2.138	52.083	1.116	30.255
	Freezing	14.573	2.138	52.083	1.116	30.255
Six months	Sun drying	16.880	2.425	69.925	1.803	8.750
	Lab.drying	17.425	3.402	69.263	1.800	8.050
	Freezing	17.145	2.053	50.020	1.610	29.235
LSD($P \leq 0.05$)		0.392	0.331	0.222	0.014	0.590

The Rheological properties

Table 2 showed that highly significant difference among amylograph parameters in the three treatments of preservation after six months of storage. Cooked the wheat for a long time during preparation of burgul contributed to form gelatinized starch which decreased the ability to absorbed water, but in each treatments of sun drying and laboratory drying some amount of the ungelatinized starch were remained which supported to absorbed the water at 60-66°C that gave a good viscosity in the doina helps the amylograph to recorded it, while freezing of the Doina samples and thawing it was caused break down of the starch granuals and that gave a low viscosity (55 AU) comparing to the viscosity in the sun drying and lab.drying which were at 310 AU and 340 AU respectively, this results were reported by Zainulabiden et al (2015) and Tamime et al (2000). That means that a preservation of Doina by sun-drying and laboratory drying were appeared better than freezing to get a good viscosity.

Titrateable acidity and pH values

Each of acidity% as lactic acid and pH values of preservation treatments are illustrated in table 2, preservation of Doina by laboratory drying for six months had a lowest acidity and a highest pH value which were 1.12% and 5.2 respectively, compared with sun drying method which had a high acidity and low pH value 1.35% and 4.5 respectively and had no significant difference with the freezing samples in the pH value, this agrees with same results of Gadallah and Hassan(2019), while the three treatments differed significantly with each other in the titrateable acidity, the activity of Lactic acid bacteria was caused increased acidity during fermentation step of Doina preparation and that reported by Huner and Bahrouz(2004). Although the water activity was low in the treatments of sun-drying the lactic acid bacteria had some activity in these conditions during the storage, that reported by Gadallah and Hassan(2019).

Table 2: Amylograph parameter, Titrateable acidity and pH values of Doina after six months of storage

Preservation methods	Parameters				
	Gelatinization Temperature °C	Peak Viscosity Temperature °C	Peak viscosity AU	Titrateable acidity	pH values
Sun drying	60	97	340	1.350	4.5
Lab.drying	66	99	310	1.120	5.2
Freezing	82	90	55	1.270	4.7
LSD(P≤0.05)	1.998	1.998	11.592	0.016	0.258

Microbial analysis

Table 3 indicates the results of microbial analysis of the Doina treatments by three preservation methods, observed. Total bacterial count (TBC) was 130×10^6 , 72×10^6 and 25×10^6 cfu in the sun drying, lab.drying and freezing samples respectively, no large difference was found between the three different treatments, these TBC more than which found by Tamime et al (2000), Gadallah and Hassan(2019). growth of coliform bacteria were not observed in all the treatments, that was expected, because produced of Doina was under aseptic condition, and in another side it had a high acidity that reported by Daglioglu et al(2002). It could be observed that yeast and moulds of the Doina treatments were ranged from (25×10^3 to 60×10^3) cfu. Also these results more than the results of Tamime et al (2000), Gadallah and Hassan(2019). The total count of Lactic Acid Bacteria LAB in the different of the Doina treatments were (133×10^6 , 95×10^6 and 100×10^6) in the sun drying, lab.drying and freezing samples respectively, this result agrees with Huner and Bahrouz (2004). LAB caused a fermentation of the fresh Doina during prepared it, so a high count of LAB found after storage that reported by Gadallah and Hassan(2019) and Daglioglu et al (2002). *Lactobacillus delbrueckii* sub sp.bulgaricus, *Lactobacillus acidophilus*, *Lactobacillus planetarium* were identified

in the three different treatments of the Doina by using API 50 CHL, some of the results similar to Huner and Bahrouz(2004)results.

Table 3: The Microbial Analysis of the Doina treatments after six months of storage

Microbial Tests (log CFU/g)	Preservation methods		
	Sun Drying	Lab. Drying	Freezing
Total Bacterial Count	130×10^6	72×10^6	25×10^6
Coliform Count	ND	ND	ND
Yeast and Mold Count	60×10^3	25×10^3	35×10^3
Lactic Acid Bacteria Count	133×10^6	95×10^6	100×10^6

ND: not detected

Sensory Evaluation

Table 4 pointing to the sensory evaluation of the Doina after six months in the different of preservation methods, sun drying samples had a high score of sensory evaluation compared with other samples, it had 81.367 scores of General acceptability, while the freezing samples had the lowest scores of General acceptability (62.86). Could be observed the sun drying samples got a high scores of General acceptability representing in the scores of taste, oder, Mouth feeling, colour and apperance, may be because of it had a good amount of acid as organic acid which is a desire in the doina compared with the laboratory drying samples which had the lowest acid and recorded a low scores of taste, significant differences were observed among the sun drying samples and each of laboratory drying and freezing samples in properties of fermenting and lactic, a good amylograph parameter helps to gave fain mouth feeling properties were(4.8,5 and 4.4) scores of Creamy, Sandy and Granules respectively in the sun drying samples, while in the laboratory drying and freezing were (4, 5 and 4.1) and (3.9, 5 and 4) scores respectively, same results that showed by Gadallah and Hassan[13], while Muir et al (2000) and Tamime et al (1997) showed that mouth feeling of kishk associated with the type of grain, rancidity was not observed in all the Doina treatment due to produce it from butter milk which a free fat, in addition that Merhi (1994) showed that the treated each of burgul and milk by the temperature during the preparation of the Doina enough to inactivation of the milk lipase, so no significant difference between the sun drying and laboratory drying samples in the rancidity property, no significant difference found among the treatments in the sandy and granule properties but the sun drying treatment differ with the freezing treatment in the creamy properties. Also, all the treatments did not differ significantly with each other in the colour and appearance properties.

Table 4: Sensory Evaluation of Doina samples

Treatments of preservation	The sensory characteristics (0-max.) points											
	Taste(0-50)				Oder(0-20)			Mouth feeling (0-20)			Colour & app - earance (0-10)	General acceptability (0-100)
	Fermenting (0-20)	Lactic (0-10)	Rancidity (0-10)	Sour (0-10)	Alcoholic (0-5)	Lactic (0-5)	Fermenting (0-5)	Creamy (0-5)	Sandy (0-5)	Granules (0-5)		
Sun drying	19	9	8	9.1	4.567	5.00	4.5	4.8	5	4.4	8	81.36
Lab.drying	15	7	7	8.5	4.00	3.50	3.0	4.0	5	4.1	8	69.10
Freezing	14	7	6	7.0	3.500	3.46	3.0	3.9	5	4.0	6	62.86
LSD(P≤0.0)	1.615				0.861			0.817			2.579	

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تأثير طرق الحفظ المختلفة على بعض الصفات الفيزيوكيميائية والميكروبية والحسية لمنتج الدوينة الحبوبى اللبنى المتخمّر

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المستخلص

استخدمت ثلاث طرق لحفظ منتج الدوينة الحبوبى اللبنى المحلى حيث تم تصنيعه من حبوب القمح الخشن الموصلى وكانت نسب خليط الدوينة 3:1 لكلا من البرغل الناعم حجم حبيباته μm (1000-1500) ولبن الخض، واضيفت المعززات الحيوية *Lactobacillus acidophilus* , *Lactobacillus planetarium* التي تم تشخيصها مع بكتريا *Lactobacillus* *delbrueckii* sub sp. *Bulgaricus* باستخدام kit (API50 CHL) بعد ستة اشهر من الخزن، وجدت هناك فروقات معنوية ($P \geq 0.05$) للتركيب الكيماوي للدوينة المحفوظة بطرق مختلفة (التجفيف الشمسي، التجفيف المختبري، والتجميد) لوحظ ان استخدام طريقة التجفيف الشمسي وهي الطريقة المحلية الشائعة لحفظ الدوينة تسببت في خفض درجة حرارة التهلّم لخليط الدوينة والذي سجل اعلى حد لزوجة في اختبار الاميلوكراف مقارنة مع طريقة الحفظ بالتجميد التي لم يحدث فيها التهلّم الا بدرجة قليلة وعند درجات حرارة عالية كما اعطى درجة لزوجة منخفضة في اختبار الاميلوكراف ، ووجدت فروقات معنوية ($P \geq 0.05$) للدوينة المحفوظة بالطرق المختلفة بعد تقييمها حسيا الا ان النماذج التي كانت مخزونة بالتجفيف الشمسي حصلت على اعلى درجات التقييم الحسي تلتها النماذج المخزونة بالتجفيف المختبري ثم النماذج المخزونة بالتجميد.

الكلمات المفتاحية: دوينة، طرق الحفظ، الاميلوكراف، البكتريا الحيوية