American Journal of Health Research
2021; 9(2): 46-49
http://www.sciencepublishinggroup.com/j/ajhr
doi: 10.11648/j.ajhr.20210902.13
ISSN: 2330-8788 (Print); ISSN: 2330-8796 (Online)

Effect of Vacuum Packaging on Chewiness of *Kradi* Cheese Stored at Different Temperatures

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To cite this article:
Hilal Ahmad Punoo. Effect of Vacuum Packaging on Chewiness of *Kradi* Cheese Stored at Different Temperatures. *American Journal of Health Research*. Vol. 9, No. 2, 2021, pp. 46-49. doi: 10.11648/j.ajhr.20210902.13

Received: April 3April 3, 2021; **Accepted**: April 23, 2021; **Published**: May 14, 2021

Abstract: In this study effect of vacuum packaging and storage time on chewiness of kradi cheese stored at 25°C, 5°C and -20°C for different periods was studied. It was observed that both vacuum packaging and storage time had an influence on chewiness of cheese. At 25°C storage temperature initial chewiness of 52.41 N.mm in vacuum packed samples decreased to 33.24 N.mm on 20th day whereas in normal packed samples it decreased to 23.11 N.mm on 15th day of storage. At 5°C of storage temperature, the initial chewiness of 52.41 N.mm in vacuum packed samples decreased to 17.21 N.mm till 16th week of storage while in normal packed samples it decreased to 17.45 N.mm till 14th week of storage. At -20°C decrease in chewiness was very slow as compared to refrigeration temperature. At -20°C chewiness of kradi cheese was better maintained than at refrigeration temperature of 5°C in vacuum packaging and the product can be stored for long time at -20°C in vacuum packaging. Chewiness decreased more in normal packed samples than vacuum packed samples. The vacuum packaging retarded chewiness changes in comparison to normal packaging. Vacuum packaging of kradi cheese exhibited possibility of preserving kradi cheese for longer time as compared to normal packaging.

Keywords: Kradi Cheese, Vacuum Storage, Temperature, Chewiness

1. Introduction

Texture refers to those qualities of a food that can be felt with the fingers, tongue, palate, or teeth. Foods have different textures, such as crisp, crunchy, hard, tender, chewy and sticky [5]. The term 'food texture' embraces a large number of textural characteristics which are identified and evaluated by the consumer in a well-defined order during mastication. Consumer preference is important to the food manufacturer, who wants to gain as wide a share of the market for the product as possible [7]. Measuring texture of foods involves use of physical techniques to objectively evaluate food quality, such as texture analysis. Instrumental evaluation of texture is performed with a texture analyzer which involves measuring the response of a food when it is subjected to a force, such as cutting, shearing, chewing or compressing [6]. A vast range of food texture fixtures are available that provide this range of mechanical texture analysis possibilities. Such tests are essential in the food industry for measuring texture, especially for routine quality control of food products. Texture analyzers are used to measure many properties, such as hardness, chewiness, brittleness, spreadability, adhesiveness, tensile strength, extensibility, etc., on a vast range of products. Texture is also an index of food quality. Texture has a role in deciding the quality of cheese [8]. Quality is difficult to define precisely, but it refers to the degree of excellence of a food and includes all the characteristics of a food that are significant and that make the food acceptable. Chewiness is the time required to masticate sample of cheese at a constant rate of force application so as to reduce it to a consistency that makes it easy for swallowing.

The texture of food can change as it is stored for various reasons. Cheese can become hard and stale on storage and this would be considered deterioration in its textural quality. The textural degradation of cheese is not desired during storage. Such textural changes induced during storage can alter the quality of product [4]. Kradi cheese is one of the ethnic cheese of Jammu Kashmir having unique textural characteristics. Vacuum packaging can reduce textural

deterioration in cheese as compared to ordinary packaging. The replacement of air with vacuum in vacuum packaging can either increase or decrease chewiness changes during storage of *kradi* cheese. The vacuum packaging can be a way of preserving textural quality of *kradi* cheese. Vacuum packaging can preserve the soft texture of cheese [17]. The sale of *kradi* cheese is increasing annually and the product is stored at refrigeration in normal packaging. Kradi cheese is usually stored at different temperatures by the retailer for sale, there is need to study effect of packaging conditions on chewiness of product with an aim to improve the overall quality of the product so that the product remains acceptable to consumers with respect to quality. Physico chemical, microbiological, microstructural properties, descriptive sensory analysis and chemical changes during storage of *kradi* cheese have been reported [9, 10, 13, 12]. Since chewiness is important textural quality judged by consumer at the time of purchasing the kradi cheese, however no studies have been reported with respect to changes in chewiness of kradi cheese during storage. It would be immensely interesting, therefore, to know as how packaging conditions influence the chewiness properties of *Kradi*. Therefore present study was aimed at assessment of changes in chewiness of *kradi* cheese throughout its storage at different periods at different temperatures under vacuum and non vacuum conditions.

2. Materials and Methods

2.1. Preparation of Kradi Cheese

Kradi cheese was made as per the method described [9]. The fresh product was packed in multilayer laminates under vacuum and normal conditions and stored at three different temperatures, 25°C, 5°C and -20°C. The products stored were evaluated at one day interval at 25°C, on weekly interval at 5°C and on monthly interval at -20°C to monitor changes in chewiness of textural properties.

2.2. Texture Profile Analysis (TPA)

The textural profile of *kradi* cheese was performed using TAXT-2i (Stable Micro System, UK) fitted with a 25 kg load cell. The cubes of *kradi* cheese samples 1x1x1 cm^2 were subjected to mono-axial compression up to 80% of its original height on the textural analyzer. The TPA was carried out at 25°C after tempering the sample for 1 h at this temperature. The textural parameter of chewiness was determined according to the method [2].

2.3. Statistical Analysis

The data obtained during the present investigation was compared by one-way analysis of variance (ANOVA) with the application of SYSTAT software, version 6.0.1 copyright © 1996, SPSS INC and also by Microsoft® Excel StatPro™ (Palaside Corporation, Newfield, NY). Significant difference ($p<0.05$) among treatments were detected using Duncan's multiple range tests.

3. Results and Discussion

The chewiness of *Kradi* samples exhibited a decreasing trend (Table 1) throughout the entire storage period in all the samples packed in two types of atmospheres and stored at different temperatures for different periods. The initial value of chewiness 52.41 N.mm in normal packed samples decreased to 23.11 N.mm on 15th day of storage while in vacuum packed it decreased to 33.24 N.mm on 20th day at 25°C. This indicates that decrease in chewiness was slow under vacuum conditions as compared to normal conditions. The chewiness measurement at 25°C was stopped after 15th day of storage in normal packaging as the samples were not sensorialy accepted while samples packed under vacuum chewiness measurement continued till 20th day of storage. ANOVA revealed that effect of packages and storage periods was highly significant ($p\leq0.01$) on the chewiness of samples stored at 25°C. Soy paneer prepared from admixtures of skim cow milk and soymilk stored at 25°C for fifteen days showed decrease in chewiness [11]. Sliced cheese stored at 25°C during storage showed decrease in chewiness [14]. At 5°C of storage temperature, the initial chewiness 52.41 N.mm in normal packed samples decreased to 17.45 N.mm after 14th week of storage while in vacuum packed samples it decreased to 17.21 N.mm after 16th week of storage. The chewiness measurement at 5°C was stopped after 14th week of storage in normal packaging as the samples were not sensorialy accepted while samples packed under vacuum were sensorialy acceptable till 16th week of storage. Sliced cheese stored at 4°C during storage showed decrease in chewiness [14]. White soft cheese made from buffalo and cow milk mixtures stored at 4°C for three month showed decrease in chewiness [3]. Mozzarella cheese stored in different atmospheres at 7°C reported decrease in chewiness of entire storage period [1]. Soy paneer prepared from admixtures of skim cow milk and soymilk stored at 5°C for ninety days reported decrease in chewiness [11]. Paneer showed decrease in chewiness stored at 4°C for 7 days [15]. In soft caprine milk cheese chewiness was more in six month old cheese as compared to three month old cheese stored at 4°C [16]. Softening was observed in manchego style cheese during ripening for 180 days at 10°C [18]. ANOVA (Table 2) revealed that type of packages and storage periods had highly significant ($p\leq0.01$) effect on the chewiness of samples stored at 5°C. At -20°C of storage temperature, the initial chewiness 52.41 N.mm in normal packed samples decreased to 35.1 N.mm after 6 months of storage while in vacuum packed samples it decreased to 36.52 N.mm after 6 months of storage. This indicates that decrease in chewiness was slow at deep freeze as compared to refrigeration temperature. Soy paneer prepared from admixtures of skim cow milk and soymilk stored at -20°C for five months reported decrease in chewiness [11]. In soft caprine milk cheese, cheeses stored for two days at 4°C were less chewy than cheeses stored at -20°C for three and six month [16]. ANOVA (Table 2) revealed that packages and storage periods had highly significant ($p\leq0.01$) effect of on the chewiness of samples

stored at -20°C. Since chewiness values were maintained for longer periods under vacuum packaging at all temperatures of storage in kradi cheese, so this gives rich mouth feel and increases the taste of kradi cheese.

Table 1. *Effect of vacuum packaging on textural characteristics of Kradi cheese stored at 25°C, 5°C and -20°C.*

Period of storage (Days)	Temperature of storage (25°C) chewiness		Period of storage (weeks)	Temperature of storage (5°C) chewiness		Period of storage (months)	Temperature of storage (-20°C) chewiness	
	VP	NP		VP	NP		VP	NP
1	52.41	52.41	1	52.41	52.41	1	52.41	52.41
2	51.24	50.21	2	51.12	49.41	2	50.41	48.63
3	50.24	47.31	3	48.54	47.41	3	47.21	45.12
4	49.63	45.85	4	45.74	44.14	4	44.21	42.13
5	48.25	43.56	5	41.42	41.25	5	40.25	38.41
6	47.51	41.11	6	37.41	38.45	6	36.52	35.10
7	46.27	39.55	7	34.15	34.15			
8	45.41	37.42	8	31.12	29.11			
9	44.41	35.41	9	28.45	27.15			
10	43.25	33.21	10	26.41	25.41			
11	42.58	31.57	11	25.11	23.22			
12	41.52	29.65	12	23.98	21.12			
13	40.35	27.65	13	22.12	19.25			
14	39.63	25.41	14	21.12	17.45			
15	38.52	23.11	15	19.01	-			
16	37.54	-	16	17.21	-			
17	36.54	-						
18	35.14	-						
19	34.15	-						
20	33.24	-						

Table 2. *Analysis of variance for textural characteristics of Kradi stored at 25°C, 5°C and - 20°C.*

Attribute	df (between packaging systems)	Mean sum of squares		F- Value
		Packaging system	Time interval	
Chewiness (at 25°C)	1	1089.77	157.91	72.40**
Chewiness (at 5°C)	1	28.28	329.05	23.43**
Chewiness (at -20°C)	1	6.23	114.73	15.51**

* * Significant at 1% level of probability

4. Conclusion

The effects of vacuum packaging of *kradi* cheese revealed that decrease in chewiness values under vacuum was slow as compared to ordinary packaging. Chewiness of product was better maintained at refrigeration temperature of 5°C in vacuum packaging and the product can be stored for long time at -20°C. Therefore vacuum packaging could be an alternative to conventional normal/open packaging for *kradi* cheese in maintaining textural quality. Thus vacuum packaging can be employed for *kradi* cheese by producers of this traditional regional product and it can guarantee the consumers a quality product. Vacuum packaging provided an option to producer for storing the kradi cheese for longer time thereby providing economic benefit. Vacuum packaging will therefore offer manufacturers to store the product for longer time with maintained textural quality.

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