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# Study on Quantifying and Correlating the Texture Profile of a Khoa based *KajuKatli* with its Moisture Content during Storage

**Snehal P. Lokhande[1*], Prashant G. Wasnik[2], Rupesh P. Datir[3], Pranita R.Chaure[1] and Sagar A. Mahulkar[4]**

*[1]Animal Husbandry and Dairy Science Section, MarotraoWadafale College of Agriculture, Yavatmal (MS), India*
*[2]College of Dairy Technology, Warud (Pusad), MAFSU, Nagpur, India*
*[3]College of Dairy Technology, Udgir, MAFSU, Nagpur, India*
*[4]Food Science Section, Gramin Science College, Vishnupuri, Nanded, India*

**Corresponding author*

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**A B S T R A C T**

The present study was undertaken to study the effect of storage temperature on the textural properties of market samples of *KajuKatli* and to investigate the significance of the effect of ambient (fluctuating) versus steady storage temperature conditions on the textural properties of products. Ambient storage in the glass shelves or jar is the most common and preferred method of storage by sweet vendors in India. So, the market samples of product were procured and stored at designated temperature conditions, 5 ± 1°C, 80± 5% RH) incubator at (18 ± 1°C, 55± 5% RH) and (30 ±1°C, 55± 5% RH), and at ambient condition (18 – 30°C, 70 ± 5%RH) for different time periods and analysed for change in textural properties. From the results, it can be concluded that the common market practice of storage of *KajuKatli* under ambient temperature conditions does not adversely affect its textural quality for the indicated shelf life.

## Introduction

*KajuKatli* is one of the most popular Indian sweets because of its delicate texture, good flavor and excellent mouthfeel. *Kajukatli* (literally "cashew slice"), also known as kaju barfi, is an Indian dessert similar to a barfi. Kaju means cashew; Barfi is often made by thickening milk with sugar and other ingredients (such as dry fruits and mild spices). Despite their high cost, cashew nut products are always in demand. Several compositional and environmental factors have influence over the quality attributes of cashew nut sweets. Moisture reduction below 9.5 per cent (dry weight basis) renders the product hard in body and coarse in texture, thereby affecting its acceptability (Aneja *et al.*, 2002). Normally, the product is stored in shelves under ambient storage conditions which are subject to fluctuations with that of the atmosphere. The typical mouth feel of the

confection has been its main appealing characteristic and experts suggest that such mouth feel is not experienced with any other product. Hence, the research significance of quantifying its mouthfeel in terms of textural attributes was felt.

The need to study correlation with its water content, which is a crucial parameter for most of the khoa based products, was also realized. A study was undertaken to evaluate the chemical composition and textural properties of *KajuKatli*as affected by the storage temperature and to check for correlation between moisture content and textural characteristics.

## Materials and Methods

*KajuKatli* was obtained in a lot from the same batch and packed in sealed polythene and cardboard boxes from Ranade Dairy, Yavatmal. The boxes were lined with pre-sterilized glossy paper. The cardboard boxes were put in polyethylenebags to prevent moisture migration during transport.

The moisture content, titratable acidity, ash content, protein contents were estimated as per BIS (SP:18, Part XI, 1981). The fat content was determined by BIS (SP:18, Part XI, 1981) and total carbohydrate content was determined by difference. The chemical composition of *KajuKatli* is shown in Table 1. The texture profile was determined by using TA-XT2i Texture Analyzer (Stable Micro Systems Ltd., UK) equipped with 50 kg load cell. The deformation curve obtained for a two-bite deformation cycle, using 75 mm diameter compression plate was used to determine textural characteristics viz. hardness, fracture ability, resilience, cohesiveness, springiness, gumminess, chewiness and adhesiveness at specific analyzer settings (Bourne, 2002).

Samples of *KajuKatli* were stored at different temperature conditions, viz., refrigerator (5 ± 1$^{o}$C, 80± 5% RH), incubator at (18 ±1$^{o}$C, 55± 5% RH) and (30 ± 1$^{o}$C, 55± 5% RH), and at ambient condition (18 – 30$^{o}$C,70 ± 5% RH) for different time periods, i.e. up to the acceptability of products(designated shelf life as per manufacturer norms).Their texture analysis was done after every 7 days interval.

## Statistical analysis

The data obtained was analyzed according to Snedecor and Cochran (1967) using Microsoft Office Excel® 2007 software utilizing the add-on Data Analysis tools to calculate the means, variances, correlations and for performing one way ANOVA. Results were presented in means ± standard error of mean (SEM) and statistical significance was set at $p < 0.05$. Analysis of variance (ANOVA) was used to determine the main effects of treatments [5]. Further verification of statistical results was done by making use of Daniel's XL toolbox version 5.08, an MS Excel add-on.

## Results and Discussion

### Effect on hardness

The acceptability of *KajuKatli* is determined by the hardness, and any change induced during storage is therefore critical from the point of view of product quality.

The hardness of *KajuKatli* stored at refrigeration temperature (5 ± 1$^{o}$C) showed an increase with increase in storage period. The product becomes harder and this is attributed to the corresponding decrease in moisture content as evident from the Figure 1. The initial hardness value, obtained 2 hrs after preparation of the product was 66.742 ± 7.750 N which tended to increase to 133.599 ± 19.449 N after 13 weeks of storage, the

commonly accepted shelf-life of the product at the refrigeration temperature as per manufacturer's norms.

The hardness of *KajuKatli* stored at ambient temperature (18 ~ 30 $^{o}$C) showed an increase with increase in storage period. The product becomes harder and this is attributed to the corresponding decrease in moisture content as evident from the Figure 2. The initial hardness value, obtained 2 hrs after preparation of the product was 66.742 ± 7.750 N which tended to increase to 142.777 ± 16.984 N after 2 weeks of storage, the commonly accepted shelf-life of the product at ambient temperature as per manufacturer's norms. At other selected temperatures of 18 ± 1$^{o}$C and 30 ± 1$^{o}$C, the recorded product hardness showed a similar trend i.e. increase with increase in storage period and decrease in moisture content.

## Effect on adhesiveness

The adhesiveness of *KajuKatli* stored at refrigeration temperature (5 ± 1$^{o}$C) showed a decrease with increase in storage period. The initial adhesiveness value, obtained 2 hrs after preparation of the product was - 3.983 ± - 0.472 N.s which tend to decrease to - 1.946 ± - 0.277 N.s after 13 weeks of storage. The product becomes less adhesive and decreased to - 1.271 ± - 0.089 N.s after 2 weeks of storage. At 18 ± 1$^{o}$C and 30 ± 1$^{o}$C temperatures, the adhesiveness decreased with increase in storage period and decrease in moisture content.

## Effect on cohesiveness

The cohesiveness of *KajuKatli* stored at refrigeration temperature (5 ± 1 $^{o}$C) showed a decrease with increase in storage period. The initial cohesiveness value, obtained 2 hrs after preparation of the product was 0.215 ± 0.031 which tended to decrease to 0.134 ± 0.013 after 13 weeks of storage. The cohesiveness of *KajuKatli* stored at ambient temperature (18 ~ 30 $^{o}$C) did not show much variation with increase in storage period. At other selected temperatures of 18 ± 1$^{o}$C and 30 ± 1$^{o}$C, the recorded product cohesiveness showed a similar invariability with increase in storage period.

## Effect on springiness

The springiness of *KajuKatli* stored at refrigeration temperature (5 ± 1$^{o}$C) showed little variation with increase in storage period. The initial springiness value, obtained 2 hrs after preparation of the product was 0.194 ± 0.030 which merely changed to 0.186 ± 0.015 after 13 weeks of storage. However, the springiness of *KajuKatli* stored at ambient temperature (18 ~ 30 $^{o}$C) did show some variation with increase in storage period, and decreased to a value of 0.155 ± 0.018 after 2 weeks of storage. At other selected temperatures of 18 ± 1 $^{o}$C and 30 ± 1$^{o}$C, the recorded product springiness showed a similar trend i.e. decrease with increase in storage period and decrease in moisture content.

## Effect on gumminess and chewiness

The secondary textural parameters viz. gumminess and chewiness of *KajuKatli* stored at refrigeration temperature (5 ± 1$^{o}$C) showed an indeterminate trend with increase in storage period. The initial values, obtained 2 hrs after preparation of the product were 14.350 ± 1.754 and 2.784 ± 0.315 for gumminess and chewiness respectively, which tended to decrease initially and then increase gradually to 17.902 ± 1.444 and 3.330 ± 0.259, respectively after 13 weeks of storage. The gumminess and chewiness respectively of *KajuKatli* stored at ambient temperature (18 ~ 30 $^{o}$C) showed an increase in value with increase in storage period. At other selected temperatures of 18 ± 1$^{o}$C and

30 ± 1 $^{o}$C, the recorded product gumminess and chewiness showed a similar trend.

## Correlation analysis

The correlation between the moisture content and the textural characteristics of *KajuKatli* at the various storage conditions is as given below:

## Refrigeration temperature

For the refrigeration temperature (5 ± 1$^{o}$C), it is seen that there is high inverse correlation between moisture content and hardness (-0.849) and moderately high inverse correlation between moisture content and adhesiveness (-0.763). Cohesiveness is moderately correlated with moisture content (0.712) and highly inversely correlated with adhesiveness (-0.870). Springiness did not exhibit any significant relationship with either the moisture content or with other textural characteristics. Gumminess and Chewiness are secondary textural parameters dependent upon the primary characteristics and have not been analyzed for correlation.

## Controlled storage temperature

For the controlled storage temperature of 18 ± 1$^{o}$C, strong correlation between moisture content and cohesiveness (-0.910) and between moisture content and springiness (0.943) is exhibited. Adhesiveness is very strongly correlated with hardness (0.989) and moderately inversely correlated with cohesiveness (-0.759) and springiness (-0.804). Springiness exhibited moderate to strongly significant relationships with the moisture content and with other textural characteristics. Gumminess and Chewiness are secondary textural parameters dependent upon the primary characteristics and have not been analyzed for correlation.

**Table.1** Chemical composition of *KajuKatli*

| Constituent | *KajuKatli* |
|---|---|
| **Moisture (%)** | 12.05 |
| **Fat (%)** | 16.60 |
| **Protein (%)** | 10.99 |
| **Acidity (%)** | 0.37 |
| **Ash (%)** | 1.13 |
| **Totalcarbohydrate (%)** | 59.23 |

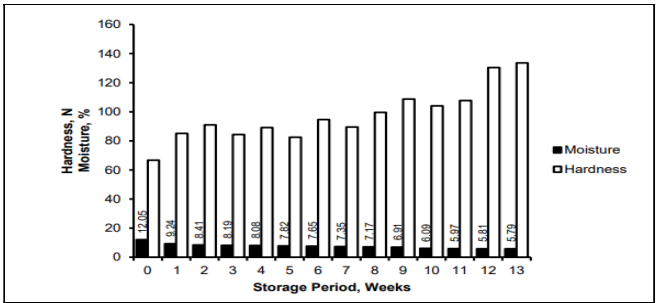


**Figure 1:** Variation in the hardness and moisture content of *KajuKatli* withstorage period at refrigeration temperature condition

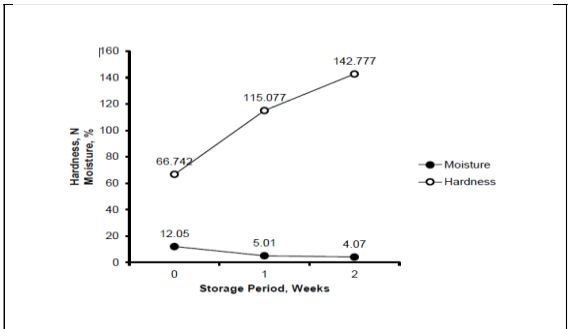


**Figure 2:** Variation in the hardness and moisture content of *KajuKatli* with storage period at ambient temperature condition

For the controlled temperature condition of 30 ± 1°C, it is observed that there is moderately high inverse correlation between moisture content and hardness (-0.749) and strong correlation between hardness and adhesiveness (0.944). Cohesiveness is moderately correlated with moisture content (0.751) and highly inversely correlated with adhesiveness (-0.943) and with hardness (-1.000). Springiness exhibited strongly significant relationship with the moisture content (0.978) and inverse strong correlation with hardness (-0.870) and cohesiveness (-0.871). Gumminess and Chewiness are secondary textural parameters dependent upon the primary characteristics and have not been analyzed for correlation.

## Fluctuating ambient temperature

For the fluctuating ambient temperature condition (18 ~ 30°C), correlation exhibited between moisture content and other textural characteristics, and between various textural characteristics was highly moderate to strong. Very strong inverse correlation between moisture content and hardness (-0.966) and high correlation between hardness and adhesiveness (0.886) is observed. Moisture content is strongly correlated with springiness (0.960), and moderately inversely with adhesiveness (-0.736) and cohesiveness (-0.735). Cohesiveness is highly correlated with hardness (0.884) and with adhesiveness (1.000). Springiness exhibited strongly significant relationship with the moisture content (0.960) and inverse strong correlation with hardness (-1.000), adhesiveness (- 0.896) and cohesiveness (-0.895). Gumminess and Chewiness are secondary textural parameters dependent upon the primary characteristics and have not been analyzed for correlation.

In conclusions moisture content of a product has direct bearing on its textural characteristics. The variation profile of the moisture content over the storage period is an important factor for determining consumer acceptance of the product based upon texture. Hardness of *KajuKatli* is not significantly affected by the fluctuation of ambient storage temperature, for the short shelf life at that temperature. Also, there are insignificant changes in primary textural characteristics on account of temperature fluctuations under ambient conditions. Therefore, it is concluded that the common market practice of storage of *KajuKatli* under ambient temperature conditions does not adversely affect its textural quality for the indicated shelf life.

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