Int.J.Curr.Microbiol.App.Sci (2025) *14*(08): 10-24

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 14 Number 8 (2025)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2025.1408.002

Storage Related Changes in Green Chickpea (*Cicer arietinum* L.), *Burfi*

Kamble Kalyani Baburao[1*] and D. K. Kamble[2]

[1]Dr.D.Y.Patil College of Agriculture, Talsande, Maharashtra-416112, India
[2]Department of Animal Husbandry and Dairy Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth Rahuri, India

**Corresponding author*

Keywords

Burfi, Green chickpea burfi, Sensory evaluation, physico-chemical quality, microbial quality, shelf life

Article Info

Received:
10 June 2025
Accepted:
22 July 2025
Available Online:
10 August 2025

A B S T R A C T

Storage conditions were known to bring about some physicochemical changes in the product. The present investigation was therefore carried out to examine effect of storage period on the sensory, physico-chemical and microbial quality of two samples made i.e. (T_0) burfi without green chickpea and (T_1) burfi added with green chickpea at an interval of 2 days. The optimized product was prepared with green chickpea paste @ 4 per cent and sugar was 25 per cent of khoa. The prepared green chickpea *burfi* was packed in laminate paper board boxes and stored at room temperature 30±1ºC and compared with control i.e. sample with 30 per cent sugar but without green chickpea paste for 6 days. During storage of burfi, the sensory scores for all attributes were decreased significantly ($P<0.05$) in burfi samples. The overall acceptability score was decreased from 7.92±0.01 to 6.15±0.01 and 8.26±0.01 to 6.17±0.01 in T_0 and T_1 respectively at the end of storage period (up to 6th days). Overall acceptability score of 6.0 as the minimum desirable for an "acceptance" of product, on the basis of sensory evaluation, the *burfi* incorporated with green chickpea (T_1) and *Burfi* without chickpea that is control (T_0) could be stored up to 6th days at room temperature 30±1ºC. During storage due to the loss of moisture content the other parameters such as fat, protein, reducing sugar, non-reducing sugar, total ash was slightly increased. The standard plate count, yeast and mould count of both samples increased during storage. The SPC counts were increased from 2.92 to 3.81 and 3.76 to 4.33 log10/g in T_0 and T_1, respectively. The growth rate of bacteria was higher in chickpea *burfi* (T_1) than control sample (T_0). There was increase in yeast and mould count from 1.34 to 1.38 and 1.40 to 1.44 log 10/g in T_0 and T_1 respectively. The coliform count was found to be nil in both samples up to 6th day of storage.

Introduction

Burfi is most popular khoa based sweet all over India and is preferred one as a premium sweet with a long shelf life of around 6 to 10 days at room temperature. It contains a considerable amount of milk solids. It is an item of choice in daily menu of children and adults. *Burfi* is popular milk-based confection in India and likely to

attain global status. Pulses occupy a unique position in every known system of farming all over the world.

Among pulses chickpea (*Cicer arietinum* L.), is the premier pulse crop of India and consumed all over the world. The origin of the chickpeas is thought to have been Levant and ancient Egypt, which is logical since the plant prefers temperate and semiarid regions. It is the member of family Leguminaceae and sub family Papilionaceae. There are two distinct types of cultivated chickpea, Desi and Kabuli. Desi (microsperma) types have pink flowers, anthocyanin pigmentation on stems, seeds are small, angular with rough brown color testas. The kabuli (macrosperma) types have white flowers, lack anthocyanin pigmentation on stem, seeds are relatively large, smooth and cream colored testas. The proximate composition of desi chickpea seed is: protein 16.7 to 30.57 per cent, fat 2.9 to 7.42 per cent, crude fiber 3.7 to 13 per cent, reducing sugar 2.61 to 4.77 per cent, non-reducing sugar 1.12 to 1.89 per cent and ash 2.04 to 4.2 per cent (Wood and Grusak, 2007).

Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass in comparison to other pulses. The protein quality is considered to be better than other pulses. Chickpea has significant amounts of all the essential amino acids except sulfur containing types, which can be complemented by adding cereals to daily diet. Starch is the major storage carbohydrate followed by dietary fiber, oligosaccharides and simple sugars like glucose and sucrose. Lipids are present in low amounts but chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid. β-sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil. Calcium, magnesium, phosphorus and especially potassium are also present in chickpea seeds. It is a good source of important vitamins 3 such as riboflavin, niacin, thiamin, folate and the vitamin A precursor, β-carotene. Chickpea has several potential health benefits and, in combination with other pulses and cereals, it could have beneficial effects on some of the important human diseases like cardiovascular disease, type 2 diabetes, digestive diseases and some cancers.

Green chickpeas also contain dietary bioactives such as phytic acid, sterols, tannins, carotenoids and other polyphenols such as isoflavones whose benefits may extend beyond basic nutrition requirements of human. Green chickpea has a low glycemic index. Diets high in fiber, low in energy density and glycemic load and moderate in protein are thought to be particularly important for weight control. Green chickpeas significantly improve insulin resistance and prevent postprandial hyperglycemia and hyperinsulinemia (Yang *et al.,* 2007). Green chickpea 4 are traditionally incorporated into many culinary creations because of their nut like flavor and versatile sensory application in food.

Overall, chickpea is an important pulse crop with a diverse array of potential nutritional and health benefits.

Materials and Methods

Materials/ Equipment's

Ingredients

Milk Fresh buffalo milk was procured from the Dairy farm, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur and standardized to 6.0 per cent fat. Green chickpea (Desi) was procured in single lot from local market of Kolhapur city (M.S.) and stored under refrigeration temperature for better keeping quality. Sugar Good quality cane sugar was procured in single lot from local market of Kolhapur city.

Utensils

Iron karahi was used for preparation of Burfi. Stirrer Long handled stirrer with flattened end made up of mild steel was used for stirring-cum scraping the milk during preparation of Burfi.

Tray Stainless steel trays (30x30x1.5 cm) were used to cool, flatten and shape burfi pieces. Stainless steel cutting knife was used to cut the *burfi* into pieces of desirable size. Mortar and pestle was used for crush green chick pea and making paste.

Packaging Material

Laminate Paper board boxes were used as a packaging material for *burfi.*

Equipments

B.O.D. incubator manufactured by Metalab Scientific Industries, Mumbai ltd. (India). pH meter Oroion-3-star

benchtop pH meter made by Thermo Scientific, Singapore, was used to measure the pH of stored burfi sample. Autoclave to sterilize the microbial media, solutions 3 KWt ratting capacity autoclave manufactured by Medica Industrial Mfg.co., Mumbai was used throughout study period.

Chemicals

All the chemicals required for the analytical work were used of Analytical Reagent (AR) or Guaranteed reagent (GR) grade manufactured by Merk India Ltd/Glaxo India Ltd. Microbiological media made by M/S Himedia laboratories used for preparation of media and microbial examination of *burfi.*

Glasswares

All the glasswares viz., petriplates, dairy microbiological pipette, test tubes, glass beakers, conical flasks etc. of Borosil make was used to analyze *burfi* for different parameters throughout the study.

Treatment

T_0 - Control *burfi* (*burfi* with 30% sugar of Khoa and without green chick pea paste)

T_1 - Green chickpea *burfi* (*burfi* added with 4 % green chickpea paste and 25% sugar of khoa)

Sensory Evaluation

Sensory evaluation of fresh and stored green chickpea Burfi samples were carried out by a semi trained panel of five judges from the Division of Animal Husbandry and Dairy Science and Division of Horticulture.

The flavour, colour and appearance, body and texture and overall acceptability was assessed by using 9-point Hedonic scale (Amerine *et al.,* 1965).

Chemical analysis

Moisture content of green chickpea burfi was determined as per SP:18 (Part XI), 1981.

Fat in green chickpea burfi sample was determined by Rose Gottlieb method for milk as described in SP: 18 (Part XI), 1981 with some modifications. Total protein in green chickpea burfi samples were determined by Micro-Kjeldhal method as described for canned Rasogolla in SP: 18 (Part XI), 1981.

The reducing sugars of green chickpea *burfi* were estimated by method with slight modification suggested by Ranganna (1986). Non-reducing sugars of green chickpea *burfi* were determined by substracting reducing sugars from total sugars. Crude fiber content in green chickpea *burfi* was determined by using standard method of A.O.A.C. (2000). The ash content of chickpea *burfi* was determined as per method IS : 1479 (Part II, 1961) for milk with slight modifications as under. Acidity (% Lactic acid) A.O.A.C. (1975) method for cheese was adopted for burfi for determining acidity in terms of per cent lactic acid. The pH was measured by Oroion-3 star pH benchtop pH meter.

Microbiological Analysis

Manual of Dairy Bacteriology, ICAR (Anon., 1982)

Statistical Analysis

To generate meaningful inferences, the data of storage samples were analyzed using Factorial Completely Randomized Design (FCRD) as per Snedecor and Cochran (1967).

Results and Discussion

Sensory Evaluation of Stored Green Chickpea *burfi*

Green chickpea *burfi* and plain *burfi* was prepared, packed in laminate paper board boxes and stored at room temperature 30±1°C to study the changes in sensory quality in terms of colour and appearance, body and texture, flavour and overall acceptability, which was evaluated at 2 days interval for 6 days.

Changes in score for colour and appearance of green chickpea *burfi* during storage at 30±1°C

The data pertaining to change in colour and appearance score of stored green chickpea *Burfi* are given in Table 1. It is revealed from Table 1 that on first day, scored 7.46 ± 0.01 for control and 8.20 ± 0.02 for chickpea *Burfi*,

which was higher than control, which gave an indication that the samples were highly acceptable with respect to colour and appearance. The colour and appearance scores were decreased from 7.46±0.01 to 6.11±0.01 and 8.20±0.02 to 6.16±0.02 in T_0 and T_1, respectively. Overall, the given storage period, treatment and their interaction showed a significant ($P<0.05$) effect on colour and appearance scores.

During first withdrawal after 2 days, there was slight decrease in the colour and appearance score of T_0 and T_1. The rate of decline in colour and appearance scores for control *burfi* (T_0) is slightly higher than chickpea *burfi* (T_1) the score 6.11±0.01 for T_0 and 6.16±0.02 for T_1 of 6th days of storage, because they became drier in appearance and lacked the greasy appearance on the surface of product desired. The present observation is in accordance with Vijayalkashmi *et al.,* (2005). Decreased in the score for colour and appearance during storage of fig *burfi* was also reported by Kamble (2010).

Changes in score for body and texture of green chickpea *burfi* during storage at 30±1ºC

The average body and texture score of green chickpea *burfi* are given in Table 3. The data showed that body and texture score were found to be decreased from 7.85±0.01 to 6.13±0.01 and 8.15±0.02 to 6.16±6.16 in T_0 and T_1 respectively. Statistically, the effect of period, treatment and their interaction were also significant ($P<0.05$).

There was slightly decrease in score for body and texture in T_0 and T_1, due to at room temperature the integrity of grains remained intact, but the grains become harder and chewier becoming conspicuous in the product as the moisture content reduces. Declined body and texture score of *burfi* during storage also reported by Reddy (1985) and Solanki *et al.,* (2002) and Kamble (2010) and Shrivas *et al.,* (2018) for *burfi*.

Changes in score for flavour of green chickpea *burfi* during storage at 30±1°C

Flavour is an important criterion for deciding the quality of the product, which in terms determines its acceptability. The sensory score for the flavour of green chickpea *Burfi* during storage are presented in Table 5. The flavour score for stored green chickpea *Burfi* were decreased significantly ($P<0.05$) during storage at 30±1°C for 6 days. The rate of decline was higher in *burfi* in T_1 than T_0 samples.

The score for flavour was found to be decreased from 8.45±0.02 to 6.21±0.01 and 8.43±0.01 to 6.19±0.02 in T_0 and T_1 respectively. Despite decreasing trends, the samples had score between 6 was liked slightly like on 6th day. The decrease in flavour score may be attributed to slight loss of freshness, and flavour become stale. The decrease in flavour score of *burfi* during storage was also reported by Reddy (1985); Bhatele (1983) and Sarkar *et al.,* (2002) in different types of *burfi* samples.

Changes in score for overall acceptability of green chickpea *burfi* during storage at 30±1°C

The average overall acceptability score for stored samples of chickpea *burfi* are given in Table 7.

Both T_0 and T_1 samples were acceptable with good score for overall acceptability up to 4th days, and on 6th day there was slight decrease in score for overall acceptability. The overall acceptability score was decreased from 7.92±0.01 to 6.15±0.01 and 8.26±0.01 to 6.17±0.01 in T_0 and T_1 respectively at the end of storage period.

Considering overall acceptability score of 6.0 as the minimum desirable for an "acceptance" of product, the product T_0 and T_1 could be stored up to 6 days at room temperature, respectively. The decreased score for overall acceptability with advancement of storage period might be attributed to the declining colour and appearance, body and texture and flavour of the product. All deteriorative changes like textural changes were collectively reflected in sensory quality and thus led to unacceptability of the stored product after a definite period. Decrease in overall acceptability score over the end of storage period was also reported by Sarkar *et al.,* (2002) for *peda* and Kamble (2010) for fig *burfi*.

Physico-chemical Changes in Stored Green Chickpea *Burfi*

Changes in moisture content of green chickpea *burfi* during storage at 30±1°C

Moisture play an important role during storage for

microbial activity, yeast and mould growth and acceptability of *burfi*. The moisture content of fresh *burfi* (Table 9) remained more or less the same for all treatments. The present study has shown that the loss of moisture in chickpea *burfi* during storage at 30±1°C. The changes in moisture during storage with different treatment (T_0 and T_1) are also graphically represented in Fig.5. The moisture content of chickpea *burfi* of T_0 and T_1 reduced from 16.10 to 14.99 and 16.23 to 15.00, respectively.

The average moisture per centage for T_0 were recorded 16.10, 15.78, 15.56 and 14.99 per cent on 0, 2, 4 and 6 days of storage, respectively. Whereas in T1 these were 16.23, 15.85, 15.61 and 15.00 per cent for above said period.

Overall, *Burfi* stored at 30±1°C for 6 days showed moisture loss during storage period. Sharma *et al.,* (2003) recorded 14.8 per cent loss of moisture from malai peda when stored at 30±1°C for 6 days. Loss in moisture content in *Burfi* during storage was also reported by Khan *et al.,* (2008); Gupta *et al.,* (2010) and Kamble (2010) in groundnut *Burfi,* coconut *Burfi* and pineapple *Burfi,* respectively. Shobha and Bharati (2007) reported that *Burfi* had moisture content of 17.58 per cent which was steadily decreased with increase in storage period. Pal (2000) suggested that *Burfi* sample having moisture content of about 15 per cent was found to be optimum for storage at 30±1°C. Several earlier workers also reported considerable loss of moisture from heat desiccated milk products during storage, which make the product dry, hard and thus sensorially unacceptable.

Changes in fat content* of green chickpea *burfi* during storage at 30±1°C

The *Burfi* samples were also analyzed for fat content. The changes in fat during storage with different treatment (T_0 and T_1) are also presented in Table 11. The fat content during storage in T_0 and T_1 were 20.15, 20.17, 20.17 and 20.18 and 20.32, 20.32, 20.35 and 20.37 respectively. The fat content was slightly increased during storage period in T_0 and T_1. The effect of storage period and treatment were found to be statistically significant ($P<0.05$). Fat of T_0 and T_1 samples slightly increase from 20.15 to 20.18 and 20.32 to 20.37, respectively on storage days 0, 2, 4 and 6 days.

Shrivas *et al.,* (2018) also observed the increasing fat content during storage of rava *Burfi.* The increase in fat content could be attributed to the decrease in moisture content with increase in storage period. The moisture loss during storage with increase in content of fat at room temperature, is a natural phenomenon as reported by several workers.

Changes in protein content* (per cent) of chickpea *burfi* during storage at 30±1°C

The present study has shown that the slightly increase in protein content in *burfi* during storage at 30±1°C. The initial protein content in T_0 and T_1 were 14.37 and 15.21 per cent, respectively. There was slightly increase in protein content in T_0 were 14.37, 14.42, 14.51 and 14.54 and in T1 were 15.21, 15.31, 15.37 and 15.41 on 0, 2, 4 and 6th day of storage. The effect of storage period and treatment were found to be statistically significant ($P<0.05$).

The slightly increase in protein content over storage period may be due to loss of moisture from all the samples. Similar findings were reported by Shrivas *et al.,* (2018) for rava *Burfi* they reported that increase in protein content could be attributed to the decrease in moisture content with increase in storage period.

Changes in reducing sugar content* (per cent) of green chickpea *burfi* during storage at 30±1°C

The reducing sugar content of fresh chickpea *burfi* samples were 19.32 (T_0) and 19.42 (T_1). The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The rate of slightly increase in reducing sugar content of *burfi* from initial value of 19.32 to 19.42 on 0 to 6 days of storage period in T_0 and 19.42 to 19.55 in T_1 respectively. The moisture loss during storage with slightly increase in reducing sugar at room temperature, is a natural phenomenon as reported by several workers and this is evident in this study also.

Changes in non-reducing sugar content* (per cent) of green chickpea *burfi* during storage at 30±1°C

The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The increase in non-reducing sugar content of chickpea Burfi could be attributed to the decrease in moisture content with

increase in storage period. Shrivas *et al.,* (2018) also observed the increase in non-reducing sugar content of during storage of rava Burfi respectively.

The changes in non-reducing content of chickpea *Burfi* during storage at 30±1°C are presented in Table 17. The statistical analyses of the data are also presented in Table 18. The initial non-reducing sugar value of chickpea *Burfi* were 26.36 and 22.84 in T_0 and T_1 respectively. During storage, there was slightly increase in non-reducing sugar content of *Burfi* in T_0 were 26.36, 26.40, 26.46 and 26.54 and in T_1 were 22.84, 22.87, 22.89 and 22.94 on 0, 2, 4 and 6th days of storage period.

Changes in total ash content* (per cent) of green chickpea *burfi* during storage at 30±1°C

Ash is the name given to all non-aqueous residue that remains after a sample is burned, which consist mostly of metal oxides. The effect of storage period and treatment was significant. There was slightly increase in ash content of, samples were 2.60, 2.61, 2.64 and 2.67 and 2.66, 2.69, 2.72 and 2.75 in T_0 and T_1 on 0, 2, 4 and 6 days of storage respectively. Shrivas *et al.,* (2018) and Kamble (2010) reported increased ash content of *burfi* during storage.

Changes in acidity (%LA) of green chickpea *burfi* during storage at 30±1°C

The changes in lactic acid in stored samples of *burfi* are presented in Table 21.The data reveal that initial average lactic acid in fresh *burfi* was 0.32 and 0.51 per cent in T_0 and T_1 respectively.

The acidity increased in all the samples within increase in storage period. The effect of storage period and treatment were found to be statistically significant ($P<0.05$). The acidity was increased from 0.32, 0.36, 0.37 and 0.39 for T_0 and 0.51, 0.55, 0.57 and 0.60 for T_1 on 0, 2, 4, and 6 days of storage. The acidity is higher in T1 as compare to T0 samples.

Earlier Palit and Pal (2005); Sarakar *et al.,* (2002), and Solanki *et al.,* (2002) were observed similar trend in acidity development during storage of *burfi.* The pH of chickpea *burfi* samples was 6.03 (T_0) and 6.20 (T_1). It decreased during storage period in all samples but at different rate. The effect of storage period and treatment were found to be statistically significant ($P<0.05$). In T_0, the rate of decrease was rapid pH from initial value of 6.03 to 5.65 and in T_1 6.20 to 5.77 during storage at 30±1°C. Kumar *et al.,* (1997) also reported decrease in pH of peda during storage for 180 days at 20°C.

Microbial Changes in Stored Green Chickpea *Burfi*

Changes in standard plate count* (log10/g) of green chickpea *Burfi* during storage at 30±1°C

The data regarding in standard plate count (SPC) of stored chickpea *burfi* is given in Table 25. According to BIS (IS: 5520:2005) standards laid down for *burfi*, the standard plate count should not be more than 30,000/g.

The standard plate count is also called as Aerobic Plate Count. This test is not a measure of the entire bacterial population it is a generic test for organisms that grow aerobically at mesophilic temperatures (25 to 40°C). It is revealed from Table 4.33 that on first day, standard plate count was 2.92 and 3.76 log10/g for T_0 and T_1 respectively.

The SPC counts were increased from 2.92 to 3.81 and 3.76 to 4.33 in T_0 and T_1, respectively. The growth rate of microbes was higher in chickpea *Burfi* (T_1) than control sample (T_0). The increase in SPC with progressive storage might be attributed to the post process contamination during handling. The mean values presented in Table 4.34 reveals that SPC were significantly ($P\leq0.05$) influenced by storage period. The interaction effect of storage period and treatment had shown significant effect on standard plate count of chickpea *burfi.*

Sachdeva and Rajorhia (1982) reported increase in SPC during storage of *burfi* at 30±2°C and 7±2°C. Other workers also reported increasing standard plate count of *burfi* during storage Garg and Mandokhot, (1984); Misra and Kuila (1988) and Shrivas *et al.,* (2018).

For most of the Indian dairy foods such as peda, *burfi*, kalakand etc. mould growth tends to be a major problem and often most important single factor limiting their shelf life. According to BIS (IS: 5550: 2005) standards the yeast and mould count for *Burfi* should not be more than 10/g of *burfi.*

Table.1 Changes in score* for Colour and appearance of green chickpea burfi during storage at 30±1ºC

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	7.46±0.01	7.42±0.01	7.37±0.01	6.11±0.01	--
T_1	**8.20±0.02**	**8.12±0.02**	**7.41±0.03**	**6.16±0.02**	--

*Mean score ± SE of 3 replication
(--) Indicates that product was spoiled and no further analysis was carried out.

Table.2 ANOVA for Changes in score* for Colour and appearance of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	66.41	966042.65	**0.010***
Between treatment	1	0.72	10430.44	**0.006***
Interaction	4	0.22	3154.86	**0.014***
Error	**18**	**0.00**	--	--

*Significant at 5 per cent level

Table.3 Changes in score* for body and texture of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	7.85±0.01	7.83±0.02	7.80±0.02	6.13±0.01	--
T_1	**8.15±0.02**	**8.11±0.01**	**7.85±0.02**	**6.16±0.02**	--

*Mean score ± SE of 3 replication
(--) Indicates that product was spoiled and no further analysis was carried out.

Table.4 ANOVA for Changes in score* for body and texture of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	70.83	1733744.90	**0.007***
Between treatment	1	0.13	3263.53	**0.004***
Interaction	4	0.03	783.80	**0.011***
Error	**18**	**0.00**	--	--

*Significant at 5 per cent level

Table.5 Changes in score* for flavour of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	8.45±0.02	8.20±0.02	7.85±0.02	6.21±0.01	--
T_1	**8.43±0.01**	**8.17±0.02**	**7.81±0.02**	**6.19±0.02**	--

*Mean score ± SE of 3 replication
(--) Indicates that product was spoiled and no further analysis was carried out.

Table.6 ANOVA for Changes in score* for flavour of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	75.06	806269.76	**0.016***
Between treatment	1	0.00	43.86	**0.007***
Interaction	4	0.00	4.27	**0.016***
Error	**18**	**0.00**	**---**	**--**

*Significant at 5 per cent level

Table.7 Changes in score* for overall acceptability of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	**2**	**4**	**6**	**8**
T_0	7.92±0.01	7.81±0.03	7.67±0.01	6.15±0.01	**--**
T_1	**8.26±0.01**	**8.13±0.02**	**7.69±0.01**	**6.17±0.01**	**--**

*Mean score ± SE of 3 replication
(--) Indicates that product was spoiled and no further analysis was carried out.

Table.8 ANOVA for Changes in score* for overall acceptability of green chickpea *Burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	70.67	3755581.16	**0.005***
Between treatment	1	0.15	7781.12	**0.003***
Interaction	4	0.05	2411.09	**0.007***
Error	**18**	**0.00**	**---**	**--**

*Significant at 5 per cent level

Table.9 Changes in moisture content* (per cent) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	**2**	**4**	**6**	**8**
T_0	16.10±0.1	15.78±0.04	15.56±0.04	14.99±0.02	**--**
T_1	**16.23±0.01**	**15.85±0.01**	**15.61±0.02**	**15.00±0.02**	**--**

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.10 ANOVA for changes in moisture content (per cent) of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	294.58	291932.83	**0.03***
Between treatment	1	0.02	21.25	**0.02***
Interaction	4	0.00	4.01	**0.05***
Error	**18**	**0.006**	**--**	**--**

*Significant at 5 per cent level

Table.11 Changes in fat content* (per cent) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	20.15±0.02	20.17±0.02	20.17±0.02	20.18±0.02	--
T_1	**20.32±0.01**	**20.32±0.01**	**20.35±0.03**	**20.37±0.02**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.12 ANOVA for changes in fat content* (per cent) of green chickpea *burfi* during storage at 30±1^{0}C

Source of variation	DF	MSS	F value	CD
Between period	4	492.26	237616.21	**0.055***
Between treatment	1	0.14	69.01	**0.034***
Interaction	4	0.01	4.48	**0.078***
Error	**18**	**0.00**	--	--

*Significant at 5 per cent level

Table.13 Changes in protein content (per cent) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	14.37±0.02	14.42±0.02	14.51±0.02	14.54±0.03	--
T_1	**15.21±0.02**	**15.31±0.02**	**15.37±0.03**	**15.41±0.01**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.14 ANOVA for changes protein content (per cent) of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	266.18	3022178.22	**0.011***
Between treatment	1	3.61	40935.24	**0.007***
Interaction	4	0.23	2565.59	**0.016***
Error	**18**	**0.00**	---	--

*Significant at 5 per cent level

Table.15 Changes in reducing sugar content (per cent) of green chickpea *burfi* during storage at 30±1^{0}C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	19.32±0.01	19.36±0.03	19.39±0.01	19.42±0.01	--
T_1	**19.42±0.01**	**19.46±0.02**	**19.50±0.01**	**19.55±0.01**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.16 ANOVA for changes in reducing sugar content (per cent) of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	452.95	419984.86	**0.012***
Between treatment	1	0.06	560.79	**0.008***
Interaction	4	0.00	37.68	**0.017***
Error	**18**	**0.00**	**---**	**--**

*Significant at 5 per cent level

Table.17 Changes in non-reducing sugar content (per cent) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	**2**	**4**	**6**	**8**
T_0	26.36±0.02	26.40±0.04	26.46±0.04	26.54±0.09	**--**
T_1	**22.84±0.02**	**22.87±0.01**	**22.89±0.04**	**22.94±0.02**	**--**

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.18 ANOVA for changes non-reducing sugar content of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	729.91	2114011.84	**0.022***
Between treatment	1	60.65	175660.87	**0.014***
Interaction	4	3.79	10983.57	**0.031***
Error	**18**	**0.00**	**--**	**--**

*Significant at 5 per cent level

Table.19 Changes in total ash* (per cent) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	**2**	**4**	**6**	**8**
T_0	2.60±0.02	2.61±0.03	2.64±0.02	2.67±0.02	**--**
T_1	**2.66±0.02**	**2.69±0.02**	**2.72±0.03**	**2.75±0.02**	**--**

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.20 ANOVA for changes in total ash of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	8.54	82098.62	**0.012***
Between treatment	1	0.03	271.09	**0.007***
Interaction	4	0.00	18.30	**0.017***
Error	**18**	**0.00**	**--**	**--**

*Significant at 5 per cent level

Table.21 Changes in acidity (% LA) of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	0.32±0.01	0.36±0.01	0.37±0.02	0.39±0.02	--
T_1	**0.51±0.01**	**0.55±0.02**	**0.57±0.02**	**0.60±0.03**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.22 ANOVA for changes in acidity (% LA) of green chickpea *burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	0.26	3581.74	**0.010***
Between treatment	1	0.19	2652.26	**0.006***
Interaction	4	0.01	167.17	**0.014***
Error	**18**	**0.006**	--	--

*Significant at 5 per cent level.

Table.23 Changes in pH of green chickpea *burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	6.03±0.06	5.96±0.01	5.80±0.02	5.65±0.02	--
T_1	**6.20±0.02**	**6.05±0.05**	**5.89±0.02**	**5.77±0.02**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.24 ANOVA for changes in pH of green chickpea *Burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	42.18	192604.11	**0.017***
Between treatment	1	0.06	296.65	**0.011***
Interaction	4	0.01	27.33	**0.025***
Error	**18**	**0.00**	--	--

*Significant at 5 per cent level.

Table.25 Changes in standard plate count of green chickpea *Burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	2	4	6	8
T_0	2.92±0.02	3.01±0.02	3.40±0.04	3.81±0.02	--
T_1	**3.76±0.03**	**3.80±0.04**	**4.14±0.06**	**4.33±0.03**	--

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Figure.1 Flow diagram for preparation of Green chickpea *Burfi*.

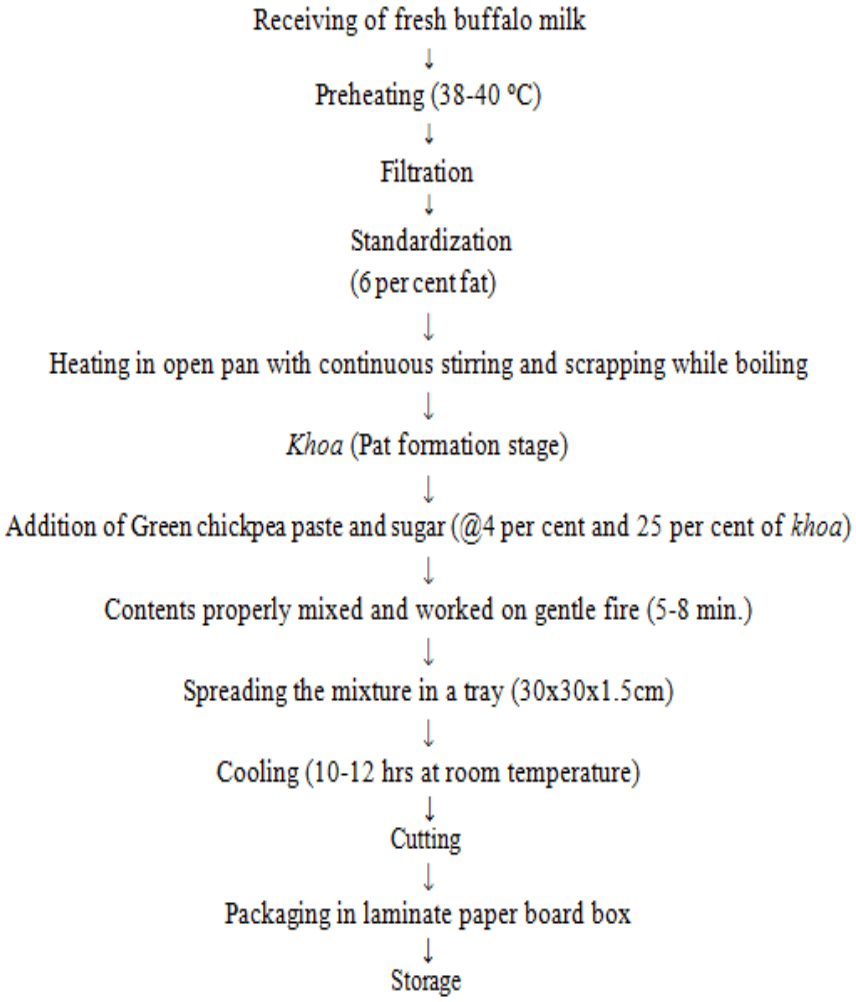

Table.26 ANOVA for changes in standard plate count of green chickpea *Burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	16.48	67008.10	**0.019***
Between treatment	1	2.52	10235.62	**0.012***
Interaction	4	0.18	732.62	**0.026***
Error	**18**	**0.00**	**--**	**--**

*Significant at 5 per cent level

Table.27 Changes in yeast and mould count*(log10/g) of green chickpea *Burfi* during storage at 30±1°C

Treatment	Storage period (days)				
	0	**2**	**4**	**6**	**8**
T_0	NIL	NIL	1.34±0.03	1.38±0.03	**--**
T_1	**NIL**	**NIL**	**1.40±0.03**	**1.44±0.03**	**--**

*Mean score ± SE of three replication
(--) indicates that product was spoiled and no further analysis was carried out.

Table.28 ANOVA for changes in yeast and mould (YMC) count of green chickpea *Burfi* during storage at 30±1°C

Source of variation	DF	MSS	F value	CD
Between period	4	3.48	24784.29	**0.014***
Between treatment	1	0.01	37.99	**0.009***
Interaction	4	0.00	14.25	**0.020***
Error	**18**	**0.00**	**--**	**--**

*Significant at 5 per cent level

The mean values regarding yeast and mould count (YMC) during storage of chickepea *burfi* are represented in Table 4.35. The YMC count was found to be nil up to 2nd day of storage. During further storage of chickpea *burfi*, increase in yeast and mould count up to 4 and 6 days in T_0 and T_1 respectively and thereafter the product was found unacceptable due to visible mould growth. There was increase in yeast and mould count from 1.34 to 1.38 and 1.40 to 1.44 log10/g in T_0 and T_1 respectively.

The colonies obtained in the present study at room temperature storage i.e. 30±1^{0}C were white and green colonies. The number of fungal colonies obtained during present investigation were similar to various researchers who analyzed the product like pedha, *Burfi*, kalakand Biradar *et al.,* (1985). Sachdeva and Rajorhia (1982); Kamble (2010) and Kuchi *et al.,* (2017) reported increase in yeast and mould count during storage of *Burfi* at 30±2°C.

Coliform Count (CC)

In the present study, coliforms count was absent in the samples of treatment T_0 and T_1 during storage. Kumar *et al.,* (1997); Palit and Pal (2005) and Shrivas *et al.,* (2018) also support the present finding of absence of coliform in *peda* and *Burfi*, respectively during processing and storage.

From the present study it was concluded that, during storage of Burfi, the sensory scores for all attributes were decreased significantly (P<0.05) in two samples. On the basis of sensory evaluation, the *burfi* incorporated with green chickpea and Burfi without chickpea that is control could be stored up to 6th days at room temperature 30±1ºC. During storage due to the loss of moisture content the other parameters such as fat, protein, reducing sugar, non-reducing sugar, total ash was slightly increased. The standard plate count, yeast and mould count in *burfi* was increased during storage. Coliform count was absent.

Author Contributions

Kamble Kalyani Baburao: Investigation, formal analysis, writing—original draft. D. K. Kamble: Validation, methodology, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

Association of Official Analytical Chemists. (1975). Official methods of analysis (12th ed.). Washington, DC: AOAC.

A.O.A.C. 2000. Official methods of Analysis of the Association of official Analytical Chemists; Washington, USA.

Amerine, M. A., Pangborn, R. M. and Roesster, E. B. 1965. Principles of Sensory Evaluation of Food. Academic press, INC, New York, USA.

Bhatele, I. D. 1983. Studies on the production, packaging

and preservation of Burfi. Ph.D. Thesis submitted to Kurukshetra University, Kurukshetra.

Biradar, U. S., Patil, R. D., & Kulkarni, A. G. (1985). Microbiological quality of Indian milk sweets. Journal of Food Science and Technology, 22(4), 210–214.

Garg, S. R. and Mandokhot, U. V. 1984. Studies on microbial and chemical profile of some Indian sweetmeats and their significance. *Indian J. Dairy Sci*. 37 (4): 326-333.

Gupta, V., Vijayalakshmi, N. S., Ashwini, B., Anbarasu, K., Vijayalakshmi, R., G., Mayaprakash, Indiramma, A. R. Rangarao, G. C. P. and Ramesh, B. S. 2010. Shelf life enhancement of coconut Burfi- *an Indian traditional sweet. J. food. quality*. 33: 329-349. https://doi.org/10.1111/j.1745-4557.2010.00312.x

IS: 1224 (Part-II) 1977. Determination of fat by Gerber method. Indian Standards Institute, Manak Bhavan, New Delhi.

IS: 1479 (Part-I) 1960. Method for test in dairy industry. Rapid estimation of milk. Indian Standards Institute, Manak Bhavan, New Delhi pp. 4-30.

IS: 1479 (Part-II) 1961. Method for test in dairy industry. Chemical analysis of milk. Indian Standards Institute, Manak Bhavan, New Delhi.

IS:5520 2005. Indian Standard specification for Burfi, Indian standard Institution, New Delhi.

Kamble, D. K. 2010. Standardization of techniques for production of fig Burfi. Ph.D. Thesis submitted to MPKV, Rahuri (MS) India.

Kamble, K. 2010. Effect of pine-apple pulp on sensory and chemical properties of Burfi. M. Sc. (Agri.) Thesis submitted to Dr. PDKV, Akola (MS).

Khan, M. A., Semwal, A. D., Sharma, G. K., Yadav, D. N. and Srihari, K. A. 2008. Studies on the development and storage stability of groundnut (*Arachis hypogea*) Burfi. *J. of Food Quality*, 31: 612-626. http://dx.doi.org/10.1111/j.1745-4557.2008.00224.x

Kuchi, V. S., Kabir, J. Bouri, F. K., Gupta, R. and Dhua, R. S. 2017. Influence of Packaging materials on quality of banana Burfi during storage., *Int. J. Curr. Micro. and App. Sci*. 6 (7): 118-127. http://dx.doi.org/10.20546/ijcmas.2016.501.014

Kumar, R., Bandyopadhyay, P. and Punjrath, J.S. 1997. Shelf-life extension of peda using different packaging techniques. *Indian J. Dairy Sci*. 50 (1): 40-49.

Misra, A. K. and Kuila, R. K. 1988. Microbiological quality of Burfi and sandesh. *Asian J. Dairy Res*.7 (1): 51-55.

Pal, D. 2000. Technology advances in the manufacture of heat desiccated traditional milk products. An overview. Indian Dairyman. 52 (10): 27-33.

Palit, C. and Pal, D. 2005. Studies on mechanized production on shelf life of Burfi. *Indian J. Dairy Sci,* 58 (1): 12-16.

Ranganna, S. (1986). Handbook of analysis and quality control for fruit and vegetable products (2nd ed.). Tata McGraw-Hill Publishing Company.

Reddy, C. R. 1985. Process modification for production of khoa based sweets. Ph.D thesis, Kurukshetra University, Kurukshetra.

Sachdeva, S. and Rajorhia, G. S. 1982. Studies on the technology and shelf life of Burfi. *Indian J. Dairy Sci*., 35: 513.

Sarkar, K., Ray, P. R. and Ghatak, P. K. 2002. Effect of sodium and potassium meta-bi- sulphites on shelf life of cow milk Burfi. *Indian J. Dairy Sci*., 55 (2): 79.

Shobha, D. and Bharati, Pushpa 2007. Preparation of Burfi from Ber – *A Value Addition. Karnataka J. Agric. Sci*., 20 (2): (448-449).

Shrivas, A. A., Pinto, S.V., Patel, S. M. and Balakrishnan, S. 2018. Effect of storage on composition, physico-chemical, rheology, sensory and microbiological quality of Indian cookie Rava Burfi. J. App. and Natural Sci., 10 (1): 88 – 97. http://dx.doi.org/10.31018/jans.v10i1.1585

Snedecor, G. W. and Cochran, W. G. 1967. Statistical Method. 6th Ed. Oxford and I. D. B. Pub. Co., Calcutta, India.

Solanki, P., Dabur, R. S. and Masoodi, F. A. 2002 Storage study of microwave treated Burfi. Indian Food Packer, pp. 153-157.

SP: 18 (Part XI) 1981. Determination of Ash. Handbook of Food Analysis. pp. 181-182.

SP: 18 (Part XI) 1981. Determination of Lactose. Handbook of Food Analysis. pp. 181-182.

SP: 18 (Part XI) 1981. Determination of Proteins by Micro-Kjeldahl method. Handbook of Food Analysis. pp. 181-182. 65

SP: 18 (Part XI) 1981. Determination of fat by Rose Gottlieb method. Handbook of Food Analysis. pp. 176-177.

SP:18 (Part XI) 1981. Determination of moisture. Handbook of Food Analysis. pp. 176.

Vijayalakshmi, N. S., Indiramma, A. R., Prema

Vishwanath, Anupama, Dattatraya and Kumar, K. R. 2005. Extension of the shelf life of Burfi by packaging. *J. Food Quality*, 28 (2):121-136.

Wood, J.A. and Grusak, M.A. 2007. Nutritional Value of Chickpea. CAB International 2007. Chickpea Breeding and Management.

Yang, Y., Zhou, L., Gu, Y., Zhang, Y., Tang, J., Li, F., Shang, W., Jiang, B., Yue, X., Chen, M., 2007. Dietary chickpeas reverse visceral adiposity dyslipidemia and inulin resistance in rats included by a chronic high fat diet. Br. J. Nutr. 98:720-726. https://doi.org/10.1017/s0007114507750870

Sharma, R., Rajorhia, G. S., & Arora, K. L. (2003). Changes in chemical quality of malai peda during storage at ambient temperature. Journal of Food Science and Technology, 40(1), 102–105.

How to cite this article:

Kamble Kalyani Baburao and Kamble, D. K. 2025. Storage Related Changes in Green Chickpea (*Cicer arietinum* L.), *Burfi. Int.J.Curr.Microbiol.App.Sci.* 14(08): 10-24. **doi:** https://doi.org/10.20546/ijcmas.2025.1408.002