JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# DEVELOPMENT AND STANDERDIZATION OF TURKISH DELIGHT

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***Abstract:***

Turkish delight is a traditional dessert. It is prepared from corn flour and sugar and a gel structure is formed. It contains several nutritive compounds such as carbohydrates, energy and high sugar content. The study was undertaken to produce stable and organoleptically preferred Turkish delight with four proportions of sugar and corn flour. Turkish delight was prepared with four proportions such as 90% sugar and 10% of corn flour, 80% of sugar and 20% of corn flour, 70% of sugar and 30% of corn flour and 60% of sugar and 40% of corn flour. Citric acid was used as preservative. The sensory properties of delight were evaluated by a testing panel consisting of 10 panelists. The results showed that color, flavour, sweetness, consistency and overall acceptability of delight between S2 and S3 as S2 is better in flavour and S3 is good in texture. So the proportion of 75% of sugar and 25% of corn flour is accepted. The storage potentiality of Turkish delight was observed that after 10 weeks S1, S2, S3, and S4 were slightly changed in chemical properties such as protein, fat, carbohydrates, etc. Turkish delight was found completely free from spoilage due to higher sugar content and perfect structure and effective processing of product.

***Keywords-*** Nutritive Compounds, Organoleptic Properties, Chemical Properties, Storage Potential, Preservative.

## I. INTRODUCTION

Turkish delight is the sugar-based jelly-like confection containing starch with a gel forming structure (Gogus, Maskan, and Kaya, 1998). It is produced from sugar, starch and water as raw materials and can be enriched with different flavours and aromas, is a traditional dessert of Turkey which is widely consumed around the world (Goluk H. *et al*., 2020). Sucrose is one of the main ingredients in the production of Turkish delight. Sugars are an important in foods whose composition includes starch, as they affect properties such as sweetness, texture, colour and gelatinization of starch (Torleya P. and Molen F., 2005). Turkish delight is a high sugar and starch containing food (Kaya S. and Tattan G. Ö., 2017).

The origin of Turkish delight (Lokum) is from the Ottoman. The beginning of production of Turkish delight is estimated to be in the 14$^{th}$ and 15$^{th}$ century and it's production has reached in the 19$^{th}$ century. In the earlier production of Turkish delight honey and pekmez were used as sweeteners instead of sugar and the flour was used to hold water and give texture instead of starch. From the end of 18$^{th}$ century, sugar was being used.

Afterwards when the flour was replaced by starch, Turkish delight become famous. In 19th century, Turkish delight was brought to England by an English tourist, then it was called "Turkish Delight" in Europe, "Lokoum" in France and Balkans, and lokomania in Greece and in Cyprus, and then lokoum took their place in international candy literature (Batu A. and Kirmaci B., 2009).

A quality Turkish delight should be elastic, leaving a soft and slippery feeling in the mouth. It is possible to state the benefits of Turkish delight as follows such as it is an energy store. It turns into energy by burning in a very short time. Turkish delight is a dessert used in the treatment of various kidney diseases. As a matter of fact, doctors especially recommend consuming Turkish delight with vanilla and cocoa. It is used to heal wounds. It helps to remove harmful substances accumulating in the body due to consuming protein food. It also helps to reduce tonsillitis.

The history of Turkish delight dates back to more than 300 years, making it one of the oldest sweet in the world. A Turkish sultan summoned all his confectionery experts and ordered them to produce a unique dessert to add to the collection of the secret recipes for which he was famous. As a result of extensive research Turkish delight was born. In 1776, during the reign of Sultan Abdul Hamid I, Hadji Bekir, a fully apprenticed confectioner, arrived in Istanbul from a small town in Anatolia. Turkish delight had been known in Anatolia since the 15th century, but it had become widespread in the borders of the Ottoman Empire (Anonymous, 2006).

Turkish delight, a traditional dessert, has existed in Anatolia and Ottoman lands since the 15th century when its name was announced to the world as "Turkish delight", and has been widely consumed by many people with a great pleasure. Originally, flour and honey were used to flavour Turkish delight products while now-a-days starch, sugar and various flavourings are widely used in their production. Depending on the type of Turkish delight, dried and chopped fruits or nuts such as peanuts, hazelnuts, almonds, flower petals or food grade pine resin can be added to these main ingredients. Sometimes, in formulations of Turkish delight natural colorants or essences specific to foodstuffs may be included. Besides being attracted by the consumers and being the leading gift on special days or occasions, Turkish delight may be good for health especially in curing or relieving various diseases like sore throat (Minifie B.W., 1989, Batu A. and Kirmaci B., 2006 , Akbulut M. and Ozen G., 2008).

Soft candy products are composed of high amounts of sugar together with different types of gelling agents, such as starch, gelatine, or pectin which are perfect examples for composite gel systems (Pocan, P.; Ilhan, E.; Oztop, M. H. 2009). Turkish delights are also an example of these soft candy products and known as traditional sugar-based jelly confections, which contain starch as the gelling agent (Batu, A.; Kirmaci, B., 2009). Turkish delight is prepared using sucrose, starch, drinking water, citric acid, or tartaric acid as the main ingredients according to the Turkish food legislation (Uslu, M. K., *et al.*, 2010).

## II. Materials and Methods:

### Materials:

The main raw materials used for preparation of Turkish delight were sugar, water, corn flour and citric acid. The other ingredients used were rose essence, red food colour, almonds and pistachios.

### Methods:

### Sensory Evaluation –9 Point Hedonic Scale

Sensory evaluation of the samples were carried out by semi-trained panelist members using nine point's hedonic scale and composite score ratings. Sensory attributes like taste, colour, appearance, flavour and overall

acceptability were analyzed. 9-Point Hedonic scale has been used for the purpose. The sensory score given by the panel have been evaluated for the sensory result.

**Table No. 1: 9 – Point Hedonic Scale**

| 9 - Point Hedonic Scale | |
|---|---|
| Like Extremely | 9 |
| Like Very Much | 8 |
| Like Moderately | 7 |
| Like Slightly | 6 |
| Neither like Nor dislike | 5 |
| Dislike Slightly | 4 |
| Dislike Moderately | 3 |
| Dislike Very Much | 2 |
| Dislike Extremely | 1 |

**Size and Shape:**

The Size and Shape of a food material can vary widely. The variation in shape of a product may require additional parameters to define its size. The shape can be round, cubical, rectangular, square, etc. and it was determined by visual appearance. The size is measure as the length, diameter, width, circumference with various scales. The size is measure by Vernier Calliper (Wilhelm, *et al.*, 2004).

**Length:**

Length is defined as the long size of product from one end to the other end. It was measured by Vernier Calliper (Wilhelm, *et al.*, 2004).

**Width:**

Width is defined as the small size of product from one end to the other end. It was measured by Vernier Calliper (Wilhelm, *et al.*, 2004).

**Thickness:**

The thickness of the Turkish delight was measured in centimetres with the help of Vernier Calliper (Wilhelm, *et al.*, 2004).

**Colour:**

Colour is the visual perceptual property deriving from the spectrum of light interacting with the photoreceptor cells of the eyes. Colour of Turkish delight states the freshness and its stability. It is the outer appearance of delight and it was determined by colour (Wilhelm, *et al.*, 2004).

**Texture:**

Texture was determined by texture analyser.

**Determination of moisture content of Turkish delight:**

Moisture content was determined in hot air oven. Firstly weigh 10 g sample accurately and subject to oven drying at 110℃ for 4-5 hour. Oven dried samples were cooled in desiccators and weighed. The drying was repeated until the constant weights were obtained or until the difference between two successive weighing was

not more than 0.002g. The resultant loss in weight was calculated as percent moisture content (Okey F. O., Sunday L.E. and Chidinma O. E., 2016).

$$\% \text{ Moisture} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

**Determination of ash content of Turkish delight:**

Ash content was determined in muffle furnace. Firstly note the empty weight of the crucible and the weigh 10 g sample of Turkish delight in the crucible. Keep the crucible in muffle furnace and set its temperature and time at 550℃ at 4 hours. Then cool the dishes in desiccator and weigh the content. Then note the difference of content and calculate the ash content in % (Ng. Mui Chng, 1980).

$$\% \text{ Ash} = \frac{\text{Final weight}}{\text{Initial Weight}} \times 100$$

**Determination of fat content of Turkish delight:**

Fat content was determined in soxhlet apparatus. Firstly weigh the 50 g of sample and transfer it into the thimble and plug the top of the thimble with fat free cotton. Then attach the thimble to the Soxhlet flask. Pour approximately 2 ½ cycle of Acetone into the tube in cycle to dip the sample during pouring it. With heating mantle attached to the flask maintain temperature at 55˚C. Extract the sample for 4 hours of continuous heating. Remove the thimble from the apparatus and distil off the ether. Collect the extract in flask and evaporate the excess ether from fat collected by steam bath. Cool the sample and weigh it (B. Jiang, *et al*., 2014).

$$\% \text{ Fat} = \frac{\text{Final weight}}{\text{Initial Weight}} \times 100$$

**Determination of protein content of Turkish delight:**

Protein content was determined by Kjeldhal method. Approximately 1 g of sample was hydrolysed with 15 ml concentrated sulphuric acid ($H_2SO_4$) containing two copper catalyst tablets ($CuSO_4$ / $K_2SO_4$) in a heat block at 420℃ for 2 hours. After cooling, $H_2O$ was added to the hydro lysates before neutralization and titration. After digestion in conc. $H_2SO_4$, the total organic nitrogen is converted to ammonium sulphate. Ammonia is formed and distilled into boric acid solution under alkaline conditions. The borate anions formed are titrated with standardized (HCl) hydrochloric acid, by which is calculated the content of nitrogen representing the amount of crude protein in the sample. Most proteins contain 16% of nitrogen, thus the conversion factor is 6.25 (D.A. Goulding. 2020).

**Calculate % Nitrogen as:**

$$\% \text{ Nitrogen} = \frac{\text{(ml of standard acid - ml of blank) x N. of acid x 1.4007}}{\text{Weight of sample in gram}}$$

**Calculate % Protein as:**

$$\% \text{ Protein} = \% \text{ Nitrogen} \times 6.25$$

**Determination of Total Carbohydrate Content of Turkish delight:**

The total carbohydrate content was determined by hydrolysis method. 2.5 gm sample was taken in the flask and suspended in 200 ml of distilled water. 20ml of 3N HCl was added refluxed in an air condenser for 3 hrs. On cooling, it was neutralized with alkali to pH 7.0, filtered and volume was made to 250 ml with distilled water. The total carbohydrate in the filtrate was determined by titrating it with Fehling's solution (A & B) using 1 ml of methyl blue indicator. Factor was worked out by titrating 1% dextrose with Fehling's solution. In each titration Fehling's solution in the conical flask was heated with a constant flame and titration was done with filtrate in the burette until the end point (Brick- Red colour) was obtained. The total carbohydrates content was calculated as under. Fehling's solution:- Fehling's solution A: 34.64 g of CuSO4.5H2O was dissolved in 500ml of distilled water. Fehling's solution B: 173 g of sodium potassium titrate and 50 g of sodium hydroxide were dissolved in 500 ml of distilled water. The Fehling's solution was prepared by mixing the equal volume of solution A and solution B (Hedge J.E. and Hofreiter B.T., 1962).

$$\text{Dextrose \%} = \frac{\text{Factor} \times 25}{\text{Titre value} \times \text{weight of sample}} \times 100$$

Total carbohydrate (%) = Dextrose % X 0.9

**Determination of Energy Value of Turkish delight:**

The gross energy values (Kcal/100 g samples) of the Turkish delight were estimated using the factors for protein (4 Kcal/g), fat (9 Kcal/g) and carbohydrate (4 Kcal/g). The equation is

Food energy = (% protein content × 4) + (% Fat content × 9) + (% Carbohydrate content × 4)

(Annabel L. Merrill and Bernia K. Watt, 1973).

**Procedure of Microbial Assay:**

1. **Nutrient Agar Media:**

Nutrient Agar Media is used for isolation and purification of cultures. It is used as means for producing the bacterial lawns.

**Table No. 2: Nutrient Agar Composition (Fahy P.C. and Persley G.J., 1983)**

| Content | 1 L |
|---|---|
| Distilled water | 1 l |
| Yeast extract | 2 g |
| Peptone | 5 g |
| Sodium Chloride(NaCl) | 5 g |
| Agar | 15 g |

**2. Potato Dextrose Agar:**

Potato dextrose agar (PDA) contains dextrose as a carbohydrate source which serves as a growth stimulant and potato infusion provides a nutrient base for the luxuriant growth of most fungi. Agar is added as the solidifying agent.

**Table No. 3 : Composition of Potato Dextrose Agar (Acharya T. and Hare J. 2022)**

| Content | Composition |
|---|---|
| Dextrose | 20 g |
| Potato Extract | 4 g |
| Agar | 15 g |

**3. Yeast and Mold Count:**

**Procedure of Yeast Mold count:**

- **Sample preparation:**

Analyse 25-50 g from each subsample. Add appropriate amount of 0.1% peptone water to the weighed sample to achieve 10-1 dilution, then homogenize in a stomacher for 2 min. alternatively, blending for 30-60 sec can be used but is less effective. Make appropriate 1:10 (1+9) dilutions in 0.1% peptone water. Dilutions of 10-6 should suffice.

- **Plating and incubation of sample:**
  1. **Spread-plate method**
  2. **Pour-plate method**
- **Counting of plates:**

Count colonies after 24 hours of incubation. Count plates containing 10-150 colonies. If mainly yeasts are present, plates with 150 colonies are usually countable. However, if substantial amounts of mold are present, depending on the type of mold, the upper countable limit may have to be lowered at the discretion of the analyst. Report results in colony forming units (CFU)/g or CFU/ml based on average count of triplicate set **(Valerie Tournas, *et al.*, 2001)**.

**4. Total Plate Count:**

**TPC (Total Plate Count) procedure:**

1. Sample weighed up to 25 grams, put in a sterile container.
2. Aseptically added to a solution of as much as 225 ml solution and homogenized (suspension formed has a dilution rate of 10-1).
3. With a sterile pipette, take the suspension is formed and added to 9ml sterile solution and homogenized by shaking the tube (suspension formed has a 10-2 dilution).
4. And so forth until a 10-4 dilution for each sample. From each dilution, take 1 ml and put into two petri dishes which have been labelled type of sample and dilution rate.

5. Nutrient Agar (NA) of 15-18 ml was poured into 2 series petri dish that already contains 1 ml of suspension.
6. Then turn the petri dish left, right, front, and back then let it harden. All petri dish included in the incubator at a temperature of 37℃ for 24 hours in an inverted position.
7. The number of colonies formed on petri dishes counted after the incubation period expires.
8. Total Plate Count is all colonies that grow on the medium NA Number of bacterial colonies on a petri dish is calculated at between 25-250 colonies.
9. After that amount is multiplied by the dilution obtained **(Jaka F.P Palawe)**.
10. TPC calculation method is:

$$\text{TPC (CFU/ml)} = \frac{\text{Number of colonies} \times \text{Dilutions}}{\text{Volume of sample plated}}$$

**Procedure of Preparation of Turkish delight:**

Boiling of Water

↓

Addition of Sugar

↓

Addition of Citric Acid

↓

Sugar Syrup

↓

Addition of Starch milk (Corn Starch and Water mixture)

↓

Cooking (5-10 minutes at low temperature)

↓

Smooth Shiny Structure

↓

Addition of Flavour and Colour

↓

Addition of Almonds and Pistachios

↓

Pouring in mould and shaping

↓

Cooling

↓

Cutting

↓

Turkish delight

↓

Packaging

↓

Storage

**Fig.1: Flowchart of Preparation of Turkish delight (Batu A. and Kirmaci B., 2009)**

**Procedure :**

1. **Preparing sugar syrup and starch milk**

First of all, syrup is made from sugar with enough water to melt it. Then, starch is mixed with the water. Practically, this mixture is called as starch milk. Starch milk is added to the boiling sugar syrup. In this step of boiling, acid is added to invert sugar (Anonymous, C).

**2. Cooking**

After boiling the water, sugar is added and thus sugar syrup is prepared. Then, this solution is left to boil for 5-10 minutes by stirring continuously with a spoon. Then, the starch is added, and the mixture is brought back to the boiling point for another 5-10 minutes until it becomes smooth and shiny. Then, the mixture is allowed to cool for a while, before the various flavourings are added. After the flavourings have been carefully added, the mixture is poured into moulds to set (Batu A. and Kirmaci B.,2009).

**3. Pouring and Shaping**

Cooked Turkish delight is poured into molds after adding the required additives. Stainless steel molds are used to shape the Turkish delight. The molds used change with respect to the type of Turkish delight and cutting type. Turkish delight's thickness should be 5 cm and 1.5–2.5 cm according to the cutting type as by hand using knife (Batu A. and Kirmaci B.,2009).

**4. Cooling**

Turkish delight is cooled at room temperature for 4-5 hours after pouring. Recently cooling is being done in less time with water cooling systems. All companies do not use any special process to fasten cooling. Some Turkish delight experts believe that waiting for the cooling to take place at room temperature results in high quality products (Batu A. and Kirmaci B.,2009).

**5. Cutting**

The cooled Turkish delight is placed on cutting tables. In Turkey, cutting of Turkish delight is done with hand. Different types of knives are used in hand cutting. There are three steps in hand cutting whatever be the knife's type. These steps are cutting to halve the Turkish delight's length, width and thickness (Batu A. and Kirmaci B.,2009).

**6. Packaging**

Cut Turkish delights are fitted into boxes in desired weight and transported to storage rooms for sale. To prevent the sticking Turkish delight to the box polyethylene, greasy and waxy paper is used (Batu A. and Kirmaci B.,2009).

## III. Result and Discussion:

**Result of Sensory analysis:**

Different kinds of blends were developed from sugar and corn flour. The products were developed after mixing all ingredients and cooking them and subjected to sensory evaluation. The results revealed that the mean score values for various sensory attributes viz., colour, flavour, taste, after taste and overall acceptability varied from 7.2 to 8.3.

The 4 blends prepared were analyzed by 9 point hedonic scale and composite scoring test. Results obtained by composite scoring test were shown in over wise Table.

**Table No. 4: Average Sensory Scores**

| Sensory parameters | $S_1$ | $S_2$ | $S_3$ | $S_4$ |
|---|---|---|---|---|
| Colour | 7.7 | 8.1 | 8 | 7.3 |
| Taste | 7.6 | 8.2 | 7.8 | 7.3 |
| Flavour | 7.8 | 8.3 | 7.8 | 7.2 |
| Texture | 7.2 | 7.9 | 8.3 | 7.4 |
| Overall Acceptability | 7.6 | 8.3 | 8.2 | 7.5 |

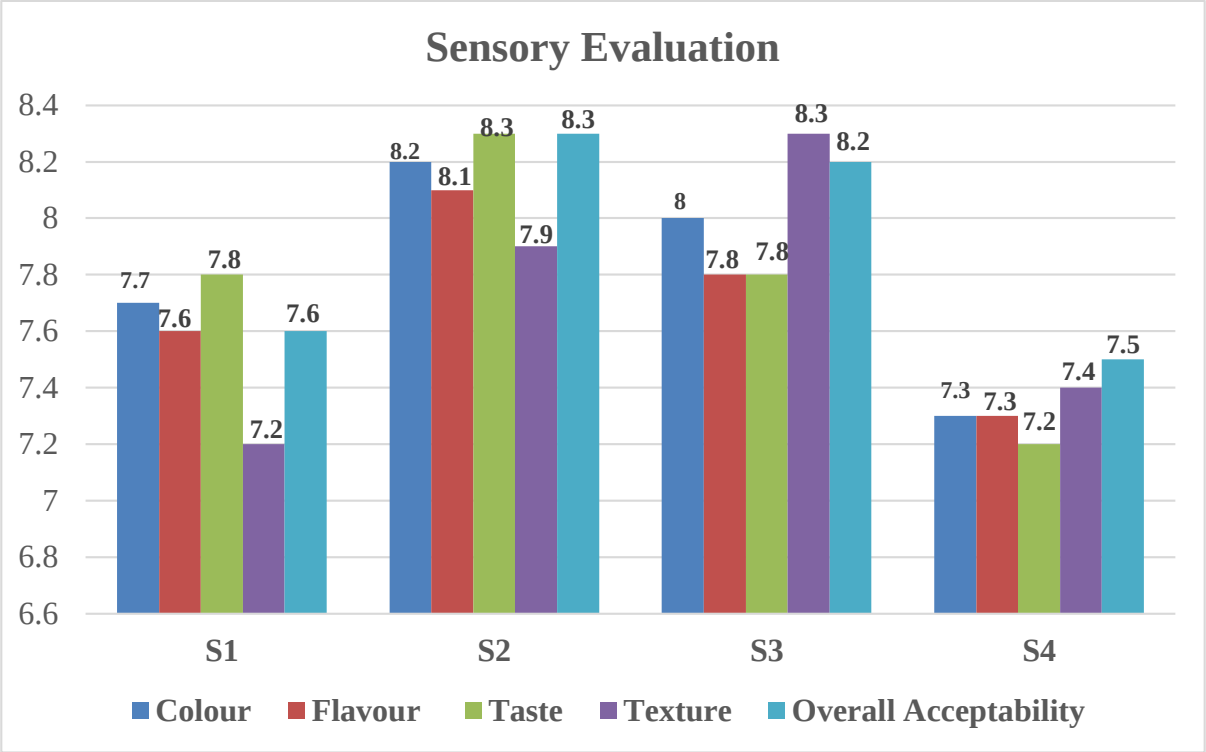


**Fig. No. 2: Graphical representation of sensory evaluation**

The sensory analysis was done by the sensory panelists and the sensory evaluation results in the proportions between S2 and S3 sample as S2 was 80% sugar and 20% corn flour and S3 was 70% sugar and 30% corn flour so in the Trial 3 the proportions were taken as 75% sugar and 25% corn flour.

**Result of physical analysis:**

**Table no. 5 : Result of physical analysis**

| Sr.no. | Parameters | Results |
|---|---|---|
| 1 | Shape | Cube |
| 2 | Length | 2.5 cm |
| 3 | Width | 1.5 cm |
| 4 | Thickness | 5 cm |
| 5 | Colour | Dark rose pink |
| 6 | Texture | Smooth |

The shape of Turkish delight was determined by visual appearance and it was found to be cube shape. The length of Turkish delight was determined by the help of Vernier Calliper and it was resulted as 2.5 cm. The width of Turkish delight was determined by the help of Vernier Calliper and was resulted as 1.5 cm. The thickness of Turkish delight was determined by the help of Vernier Calliper and was resulted as 5 cm. The color was determined by visual appearance and it was found to be dark rose pink. The texture of Turkish delight was determined by texture analyser and was found to be smooth.

**Result of chemical analysis:**

**Table No. 6: Result of Chemical Analysis**

| Sr. No. | Test Parameters | Results |
|---|---|---|
| 1 | Moisture | 70.49 g/100gm |
| 2 | Ash | 0.1 g/100gm |
| 3 | Total Fat | < 0.1 g/100gm |
| 4 | Protein | < 0.1 g/100gm |
| 5 | Carbohydrates | 29.41 g/100gm |
| 6 | Energy Value | 117.64 Kcal/100gm |
| 7 | Total Sugar | 24.81 g/100gm |

The moisture content of Turkish delight was determined by hot air oven and it was found to be 70.49 g/100gm. The ash content of Turkish delight was determined by muffle furnace and it was found to be 0.1 g/100gm. The fat content of Turkish delight was determined by Soxhlet method and it was found to be < 0.1 g/100g. The protein content of Turkish delight was determined by Micro-Kjeldhal method and it was found to be < 0.1 g/100gm. The carbohydrates content of Turkish delight was determined by hydrolysis and it was found to be 29.41 g/100gm. The energy value of Turkish delight was determined by Atwater general factor system and it was found to be 117.64 Kcal/ 100gm.

**Effect of Treatment and storage on the chemical analysis of Turkish delight:**

**Table No. 7: Effect of storage on the chemical analysis**

| | | | Storage Period (Days) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Parameters** | **Samples** | **0** | **15** | **30** | **45** | **60** | **75** | **90** | **Mean** |
| Moisture | $S_1$ | 71.89 | 71.89 | 71.89 | 71.90 | 71.92 | 71.95 | 71.96 | 71.91 |
| | $S_2$ | 71.11 | 71.11 | 71.11 | 71.13 | 71.15 | 71.16 | 71.18 | 71.13 |
| | $S_3$ | 70.49 | 70.49 | 70.49 | 70.50 | 70.53 | 70.55 | 70.56 | 70.51 |
| | $S_4$ | 69.89 | 69.89 | 69.89 | 69.90 | 69.92 | 69.93 | 69.95 | 69.91 |
| | **Mean** | 70.84 | 70.84 | 70.84 | 70.85 | 70.88 | 70.89 | 70.91 | 70.86 |
| Ash | $S_1$ | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.08 |
| | $S_2$ | 0.08 | 0.08 | 0.08 | 0.08 | 0.07 | 0.07 | 0.06 | 0.07 |
| | $S_3$ | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.09 | 0.09 | 0.09 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $S_4$ | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.09 | 0.09 |
| | **Mean** | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.08 |
| Protein | $S_1$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_2$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_3$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_4$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | **Mean** | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| Fat | $S_1$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_2$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_3$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | $S_4$ | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| | **Mean** | <0.1 | <0.1 | <0.1 | <0.1 | 0 | 0 | 0 | <0.1 |
| Carbohydrate | $S_1$ | 28.41 | 28.41 | 28.41 | 28.41 | 28.39 | 28.37 | 28.35 | 28.39 |
| | $S_2$ | 29.11 | 29.11 | 29.11 | 29.11 | 29.10 | 29.08 | 29.06 | 28.66 |
| | $S_3$ | 29.41 | 29.41 | 29.41 | 29.41 | 29.39 | 29.37 | 29.36 | 29.39 |
| | $S_4$ | 29.50 | 29.50 | 29.50 | 29.50 | 29.48 | 29.46 | 29.44 | 29.48 |
| | **Mean** | 29.10 | 29.10 | 29.10 | 29.10 | 29.09 | 29.07 | 29.05 | 28.98 |
| Sugar | $S_1$ | 23.89 | 23.89 | 23.89 | 23.89 | 23.87 | 23.85 | 23.83 | 23.87 |
| | $S_2$ | 24.41 | 24.41 | 24.41 | 24.41 | 24.40 | 24.38 | 24.36 | 24.39 |
| | $S_3$ | 24.81 | 24.81 | 24.81 | 24.81 | 24.79 | 24.78 | 24.76 | 24.79 |
| | $S_4$ | 24.90 | 24.90 | 24.90 | 24.90 | 24.88 | 24.87 | 24.85 | 24.88 |
| | **Mean** | 24.50 | 24.50 | 24.50 | 24.50 | 24.48 | 24.47 | 24.45 | 24.48 |

**1) Moisture Content:**

Data pertaining to effect of different formulations on the moisture content of Turkish delight under ambient condition of storage were presented in table 3. It is evident from the data that moisture content of delight showed slightly increase in increasing period of storage (0 to 90 days).

**2) Ash content:**

Data pertaining to effect of different formulations on the ash content of Turkish delight under ambient condition of storage are presented in table 4.5. It is evident from the data that ash content of delight showed slightly decrease in increasing period of storage (0 to 90 days).

**3) Fat Content:**

Data pertaining to effect of different combinations on the fat content of Turkish delight under ambient condition of storage are presented in table 4.5. It is evident from the data that fat content of delight showed slightly decrease in increasing period of storage (0 to 90 days).

**4) Protein Content:**

Data pertaining to effect of different proportions on the protein content of Turkish delight under ambient condition of storage are presented in table 4.5. It is evident from the data that protein content of delight showed slightly decrease in increasing period of storage (0 to 90 days).

**5) Carbohydrate Content:**

Data pertaining to effect of different proportions on the carbohydrate content of Turkish delight under ambient condition of storage are presented in table 4.5. It is evident from the data that carbohydrate content of delight showed slightly decrease in increasing period of storage (0 to 90 days).

**6) Sugar Content:**

Data pertaining to effect of different combinations on the sugar content of Turkish delight under ambient condition of storage are presented in table 4.5. It is evident from the data that sugar content of delight showed slightly decrease in increasing period of storage (0 to 90 days).

**Results of microbial analysis:**

**Table No. 8: Result of microbial analysis**

| Sample | Storage period (week) | Yeast and Mould (log CFU/g) | TPC (log CFU/g) |
|---|---|---|---|
| $S_1$ | 0 | Absent | Absent |
| | 2 | Absent | Absent |
| | 4 | Absent | Absent |
| | 6 | Absent | Absent |
| | 8 | Absent | Absent |
| | 10 | Absent | Absent |
| | 12 | 3.5 | 3.1 |
| $S_2$ | 0 | Absent | Absent |
| | 2 | Absent | Absent |
| | 4 | Absent | Absent |
| | 6 | Absent | Absent |
| | 8 | Absent | Absent |
| | 10 | Absent | Absent |
| | 12 | 4.3 | 3.9 |
| $S_3$ | 0 | Absent | Absent |
| | 2 | Absent | Absent |
| | 4 | Absent | Absent |
| | 6 | Absent | Absent |
| | 8 | Absent | Absent |
| | 10 | Absent | Absent |

| | | | |
|---|---|---|---|
| | 12 | 3.2 | 3.6 |
| $S_4$ | 0 | Absent | Absent |
| | 2 | Absent | Absent |
| | 4 | Absent | Absent |
| | 6 | Absent | Absent |
| | 8 | Absent | Absent |
| | 10 | Absent | Absent |
| | 12 | 3.1 | 3.4 |

The result showed that the storage period was highly significant on the microbial count of Turkish delight. The microbial status of the Turkish delight showed value of yeast and mould count of $S_1$, $S_2$, $S_3$ and $S_4$ are 3.5 log CFU/g, 4.3 log CFU/g, 3.1 log CFU/g and 3.2 log CFU/g as respectively. The Total Plate Count of $S_1$, $S_2$, $S_3$ and $S_4$ are 3.3 log CFU/g, 3.9 log CFU/g, 3.2 log CFU/g and 3.4 log CFU/g as respectively. The storage period on the microbial count of the Turkish delight revealed that microbial count gradually increased with the increment in storage period. The microbial count was not found until 75 days and after 75 days in the last 15-20 days the slightly growth in microbial count was observed. However the lower microbial count was observed in $S_3$ (75% sugar and 25% corn flour) i.e. 3.1 log CFU/g of yeast and mould count and 3.2 log CFU/g of TPC. The result clearly indicated the presence of antimicrobial potential is due to addition of preservatives.

## IV. Discussion:

In general, the moisture content of Turkish delight increased during storage. As the moisture content increases in the Turkish delight the Ash content decreases. The other nutritional value such as protein content, fat content and carbohydrates content and sugar content also increases slightly during storage period of 90 days. The moisture content increases of $S_3$ sample from 70.49% to 70.56% and Ash content decreases from 0.1 % to 0.09 %. The protein and fat content decreased upto negligible or zero. The carbohydrates content decreases upto 29.36 gm/100gm. The total sugar content decreased upto 24.76gm/100gm during the storage period of 90 days. The Turkish delight with different formulations was found completely free from spoilage upto 75 days and after 75 days the slightly microbial growth is observed on the Turkish delight. The microbial growth is observed after 75 days such as in sample 3. The yeast and mould growth was observed as 3.2 log CFU/g and TPC count was observed as 3.6 log CFU/g.

So from the quality evaluation of Turkish delight, it was observed that high sugar content and citric acid in Turkish delight preserve the quality and shelf life and delight for storage period of 90 days.

The chemical analysis showed that the Turkish delight is rich in carbohydrate content and sugar content and due to this it is an energy store. The fat content is negligible so healthy to consume. The protein is also low in Turkish delight.

The sensory analysis is done on the basis of parameters such as colour, flavour, taste, texture and overall acceptability and is done by the sensory panellists. The sensory analysis by the sensory panellists showed that in S1, S2, S3 and S4 the S2 and S3 are good as S2 is best in flavour and S3 is best in texture. The acceptable proportions were selected between S2 and S3 as S2 was 80% sugar and 20% corn flour and S3 was 70% sugar

and 30% corn flour and according to these in Trial 3 the proportions used were 75% sugar and 25% corn flour which were accepted.

The physical analysis results in cube shape of Turkish delight. The length was 2.5 cm and the width was 1.5 cm. The thickness was observed 5 cm and color was found to be Dark Pink and its texture is observed as smooth and soft.

## V. Conclusion:

It was concluded that the proportions between the Sample 2 and Sample 3 were accepted during the sensory evaluation then Sample 1 and Sample 4. Then after in Trial 5 the proportion of Sugar and Corn Flour are taken as 75 % and 25 % respectively to get the most effective taste of Turkish delight. It gives best colour, texture, taste, flavour and appearance to the Turkish delight and makes it suitable for commercial product and healthy and nutritious. Proximate composition revealed that product contains < 0.1g proteins, < 0.1g fats, 29.41g carbohydrates and 117.64 Kcal energy value per 100 g of Turkish delight. It is satisfactorily stored for the period of more than 30 days. Shelf life studies shows that quality product was found good for a period of 45 days. Thus, blend can be recommended for production at commercial level to make nutritious and healthy delight.

## VI. Conflict of Interest:

The authors declare that there is no conflict of interest.

## VII. Acknowledgement:

It's my sheer privilege to work under my guide (Respected) Avinash Tonde Sir. I take this opportunity to express my deep sense gratitude and respect to my teachers, guide and mentors for making me whatever I am today. I am thankful to (Respected) Avinash Tonde Sir for the opportunity to work under him for this topic, along with that for his professional devotion, vigor and for his guidance.

## VIII. References:

Akbulut, M., Özen, G. (2008). Kayısı Turkish delight üretimi ve beslenmedeki önemi. Gıda Teknolojileri Elektronik Dergisi, 1, 7-11.

Anonymous (2006). Turkish delight, Bayco confectionery Inc., Canada, Manufacturer' of authentic Turkish delight. <http://www.turkish-delight.com/>.

AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists (15th Ed.). *Association of Official Analytical Chemists*, Washington, DC.

Batu A. and Kirmaci B., (2009) Production of Turkish delight (Lokum), Food Research International (42) ,(1-7).

Batu, A. and Kırmacı, B. (2006). Turkish delight Üretimi ve Sorunları. Teknolojik Araştırmalar. GTED, (3): 37-49.

BROCKWAY, B. 1989. Applications to confectionery products. In Water and Food Quality, (T.M. Hardman, ed.) pp. 305-324, *Elsevier Applied Science, London*.

Chang, Y. H., Lim, S. T., & Yoo, B. (2004). Dynamic rheology of corn starch–sugar composites. Journal of Food Engineering, 64(2004), 521–527.

Chung, Y., & Lai, H. (2006). Molecular and granular characteristics of corn starch modified by HCl–methanol at different temperatures. Carbohydrate Polymers, 63(2006), 527–534.

Doyuran, S. D., Gültekin, M., & Güven, S. (2004). Geleneksel Gıdalardan Lokum Üretimi ve Özellikleri. In Geleneksel Gıdalar Sempozyumu, 23-24 Eylül 2004, Van (pp. 334–342).

Durak, F. (1996). Lokum _ Isleme Teknolojisi. In Seker ve Sekerli Mamüller Semineri, Manisa, 1996 (pp. 26–30).

Gogus F., Maskan M. and Kaya A., (1998), Sorption Isotherms of Turkish Delight, Journal of Food Processing and Preservation, 22, 345-357.

Goluk H., Kraal p E., Yaman T., Guler Dal H.O., Yilmaz Y., (2020), Potential Use of Capsicum Pepper Powder and Natural Cheese Aroma in Turkish Delight (Turkish delight) Production, Akademik Gida 18(3) (2020) 296-302.

I. Lurie, L. Skokan, P. Tsitovich, Technical and microbiological control in the confectionery industry (Kolos, Moscow, 2003).

Kaya C., Guldane M., Topuz S. and Bayaram M., Determination of Some Properties of Turkish Delight Produced by the Addition of Pomegranate Juice, Turkish Journal of Agriculture-Food Science and Technology, 6(12), 1814-1819.

Kaya S. and Tattan G. Ö.,(2017), Thermal and Textural Changes of Turkish Delight with Storage Relative Humidity, Journal of Food Science and Engineering 7, 186-191.

KIRCA, A. 2004, Thermal stability of black carrot anthocyanin's in some fruit products. PhD Thesis, A.Ü. Fen Bilimleri Enstitüsü, Ankara, Turkey.

Kowalczuk, J.; Rachocki, A.; Bielejewski, M.; Tritt-Goc, J. Effect of Gel Matrix Confinement on the Solvent Dynamics in Supramolecular Gels. J. Colloid Interface Sci. 2016, 472, 60−68 Kramer, A., and Ve Szczesnıak, A. S. (1973). Texture measurements of foods. Dordrecht: D. Reid Pub. Co.. p. 175.

Minifie, B.W. (1989). Chocolate, Cocoa, and Confectionery: Science and Technology. AVI Book, New York, USA.

Mohameed, Z. A., Abu-Jdayil, B., & Eassa, A. M. (2006). Flow properties of corn starch–milk–sugar system prepared at 368.15 K. *Journal of Food Engineering*, 77(2006), 958–964.

P. Penev, Production of halva and Turkish delight, (EDP Technique, Sofia, 1965).

Pocan, P.; Ilhan, E.; Oztop, M. H. Effect of D-Psicose Substitution on Gelatine Based Soft Candies: A TD-NMR Study. Magn. Reson. Chem. 2019, 57, 661−673.

R. Ibrahim, F. Abdel-Salam and E. Farahat, Food Sci. Nutr, 11, 757-772 (2020).

Shahidi F, Naczk M (1995). Food Phenolics. Lancaster, PA, USA: Technomic Publishing Company.

Shi, C.; Tao, F.; Cui, Y. New Starch Ester/Gelatin Based Films: Developed and Physicochemical Characterization. Int. J. Biol. Macromol. 2018, 109, 863−871.

Torleya, P. J. F., and van der Molen, F. (2005), Gelatinization of starch in mixed sugar systems. *LWT*, 38(2005), 762–771.

US Food and Drug Administration. 21CFR §101.80 Food labelling: health claims: dietary non-cariogenic carbohydrate sweeteners and dental caries, *Federal Register*, 73, 30299-30301 (2008).

Uslu, M. K.; Erbas, M.; Turhan, I ̧.; Tetik, N. Effects of Starch Ratios and Soapwort Extract Addition on Some Properties of Turkish delight. GIDA J. Food. 2010, 35 (5), 331−337 (in Turkish with an English Abstract).

Wilhelm, Luther R., Dwayne A., Suter and Gerald H. Brusewitz, 2004, Physical Properties of Food Materials, *Food and Process Engineering Technology*, 2, 23-52.

Okey Francis Obi, Sunday Louis Ezeoha and Chidinma O. Egwu, 2016, Evaluation of Air Oven Moisture Content Determintion Procedures for Pearl Millet, International Journal of Food Properties, 19:2, 454-466.

Ng. Mui Chng, 1980, Determination of ash, Official methods of analysis of the Association of Official Analytical Chemists, 13th Ed., 289, 508.

B. Jiang, R. Tsao, Y. Li, M. Mia, 2014, Food Safety : Food Analysis Technologies / Techniques, Encyclopedia of Agriculture and Food Systems, 273-288.

D.A. Goulding, P.F. Fox, J.A. O' Mahony, 2020, Milk proteins : An Overview Milk Proteins, 11-98.

Hedge J.E. and Hofreiter B.T., 1962, In Carbohydrate Chemistry 17 (Eds. Whistler R.L. and Be Miller, J.N.), Academic Press, New York.

Annabel L. Merrill, Bernia K. Watt, 1973, Energy Value of Foods – Sources of Food Energy, Agriculture handbook, No. 74, 1-7.

Md. Aftab Uddin, 2018, Microbiological analysis of ready to eat foods collected from different places of Dhaka city, Bangladesh, Stamford Journal of Microbiology, 8(1), 30-33.

Acharya T., Hare J. (2022) Sabouraud Agar and Other Fungal Growth Media. In: Gupta V.K., Tuohy M. (eds) Laboratory Protocols in Fungal Biology. Fungal Biology. Springer, Cham. https://doi.org/10.1007/978-3-030-83749-5_2

Fahy P.C. and Persley G.J., 1983, Plant Bacterial Diseases, A Diagnostic Guide – Academic Press, N.Y., NY, 393 pp.

Valerie Tournas, Michael E. Stack, Philip B. Mislivec, Herbert A. Koch and Ruth Bandler, 2001, Chapter 18: Yeasts, Molds and Mycotoxins, Bacteriological Analytical Manual.

Jaka F. P Palawe, TPC (Total Plate Count), WAC (Water Adsorption Capacity) Abon Selar Fish and Fish Meat Cooking Loss Selar (Selaroides leptolesis), 1-6.