Assiut J. Agric. Sci., 51 (4) 2020 (32-49) *ISSN: 1110-0486*
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Technological Studies on Aswan Dry Dates Products After Dehydration

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Received on: 13/12 /2020 **Accepted for publication on:** 15/12/2020

Abstract:

Sakkoti, Bartamuda, Gondaila, Malkabii and Shamia are excellent dry date cultivars, grown at Aswan Governorate. This study was conducted to assay effect of drying methods on quality of dates products so, total soluble solids (T.S.S.), pH, acidity, color characteristics and Organoleptic characteristics were determined in prepared date products (Tamr-Elddin Date Sheets (TDS) [with / without] fiber, Date pudding and Date Jelly) from fresh date fruit (Tamar), after sun-drying for 25 days, solar drying for 14 days at ambient temperature 50°C and mechanical drying at 60°C for 9 hrs. The obtained results showed that pH decreased after sun-drying and mechanical drying, while total soluble solids (T.S.S) and acidity increased for all date products also, in generally found that the lightness (L), a (redness) and yellowness (b) values for date products from fresh dates were higher than solar dried dates, followed by sun dried dates and mechanical dried dates. So, in this study found that drying process by solar energy improved qualities attribute of all date products that had processed from Aswan dry dates.

Keywords: *Date fruit, Technological properties, Drying, Tamr-Elddin, Jelly, Pudding.*

Introduction:

Due to the growing interest in running a healthy life, including the diet a special interest has been put in searching for products that are rich in nutrients, macro and micronutrients and vitamins. Dates are the fruits that meet these requirements and show multidirectional pro-health effects. These fruits are a source of potassium and other macro- and micronutrients (Kuras *et al.,* 2020). Number of dates derived products are now marketed such as pitted dates, cubes, paste, juice, syrup, spread, powder (date sugar), jam, jelly, sweets, meals preparations, vinegar, alcohol and many bakery and confectionary products (Abd-Ellah, 2009). Also, dates have important role as food and feed for both human and animals (Youssef and Ramadan, 1987). Borchani *et al.,* (2010) reported that various types of jellies prepared from date fruit and lemon by-products had less quantity of sugar, decreased pH, and resulted in significantly firmer jellies, with higher adhesiveness, chewiness, cohesiveness, and taste attributes and gave higher sensory evaluation. One of the oldest forms of processing and preserving food is drying. The main aim of drying is to extend the shelf life of certain foods, minimize packaging requirements and reduce shipping Weights (Okos *et al.,* 1992). The most common method throughout history for drying dates has been sun drying. This process of sun drying has its challenges in that daytime temperature and humidity cannot controlled, the fruit is in contact with the open environment (a possible source of contamination due to dust, soil, sand particles and

insects), and the fact that the process takes too much time. Due to the downsides of this processing method, sun drying does not provide an effective process for quality production (Doymaz, 2005). To reduce these problems, other forms of processing should be taken into consideration, which may improve quality in terms of color or nutrients. In today's world, it seems that the most effective and common form of processing is the convective drying method, because of its ability to reduce the moisture content in food and preserved well (Mundada *et al.,* 2010).

The objectives of this study were:

1- Prepare different date products (Tamr-Elddin Date Sheets with fiber - Tamr-Elddin Date Sheets without fiber – Date Jelly – Date Pudding) from the five date palm verities (Sakkoti, Bartamuda, Gondaila, Malkabii and Shamia) at Tamr stage of maturity.
2- Comparing the technological properties of date products when using sun, mechanical and solar energy drying methods.
3- Investigate the effect of processing methods on physical properties of the prepared date products, (especially total acidity, pH, total soluble solids, and color), and organoleptic characteristics of the prepared date products.

Materials and Methods:

Materials:

This study was carried out on five date fruits which cultivars in Aswan Governorate, Sakkoti, Bartamuda, Gondaila, Malkabii and Shamia are dry date varieties. 100 kg of different date fruits were collected during September 2018 and 2019 seasons, from their sources in Al-Akkab village, Aswan sector, 15 km north of Aswan city at random and transferred to laboratory for analysis. Each of these date fruit types was divided into four parts.

Date samples were divided into four groups (For each variety) one group was left as control (fresh), each part was counted 25 kg for each variety, while the other three groups were treated as follows for each drying method:

- The first part (I) was used as fresh (Tamar) immediately after harvesting before the cultivars prepared to dry.
- The second part (II) was dried using electric oven at 60°C. With air circulation for 10 hrs.
- The third part (III) was dried using a solar dryer, on the roof of the Faculty of Agriculture and Natural Resources - Aswan University, from mid-September, at maximum temperature of 50 °C for 14 days.
- The fourth part (IV) was dried in open air under sun rises, from mid-September, at maximum temperature of 40 °C for 25 days.

Methods:

1. Drying methods:

1.1. Solar drying: Date samples were dried by using hot air at 50 ºC for 14 hrs, the hot air was heated in direct active solar dryer has been manufacturing in local workshop – Aswan governorate, the solar drying system is shown in Fig. (1). The solar drying process was conducted on the roof of the Faculty of Agriculture and Natural Resources, Aswan University - Aswan – Egypt.

1.2. Mechanical drying at oven: Date samples were dried by using an electrical oven at 60 ºC for 10 hrs. The drying process was carried out inside the Food Sci and Tech. Laboratory - Faculty of Agriculture and Natural Resources - Aswan University - Aswan - Egypt.

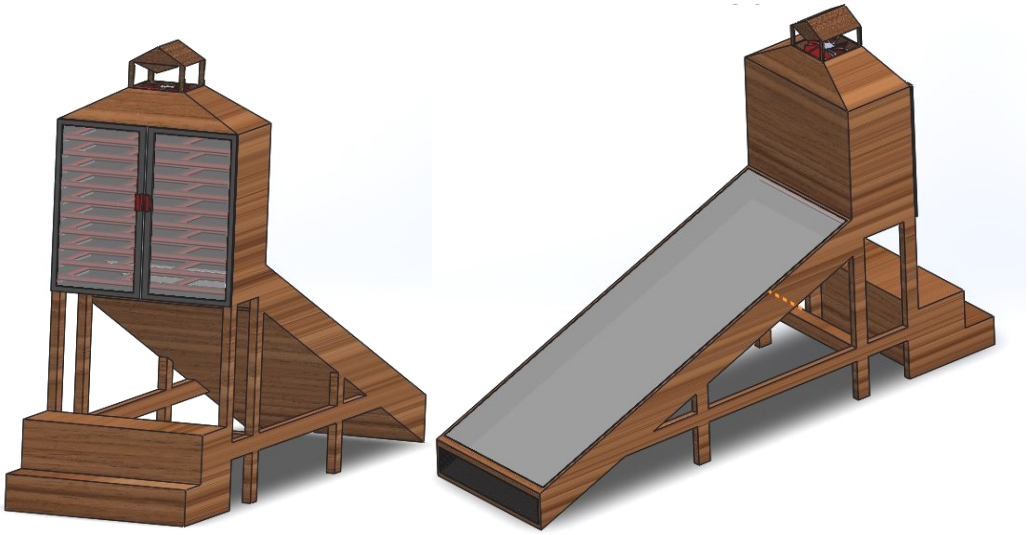

Figure 1: Isometric view of the solar drying system.

1.3. Sun drying: Date samples were dried on open air at maximum ambient temperature 40 ºC. The sun drying process started from 20 September for 25 days, on the roof of the Faculty of Agriculture and Natural Resources, Aswan University - Aswan - Egypt.

2. Preparation of date products:

2.1. Preparation of Tamr-Elddin Date Sheets (TDS) samples:

The method of Tamr-Elddin Date Sheet (TDS) preparation was carried out according to Nadir *et al.,* (2005) as following:

- Every part of the four groups of date [fresh, solar dried, sun dried and mechanical dried] of the five date verities was washed with tap water. Then, they were cut and pitted manually.
- Pitted dates were mixed with cold water at a ratio of 4 date pulp: 3 water (w/w) and 0.5 % Na-met a bisulfite (from pitted date weight) were added to the mixture to prevent discoloration.
- The mixture was cooked in pressure cooker (SEB- Express Cooker -10 L) for 30 minutes. Then it was homogenized using a blender (Braun 600 W) for 2 min.

The homogenized mixture was divided into two parts:

First: Production of TDS without Fiber:

- The previous mixture of date was strained through double cheese cloth and the extracted date juice was mixed with 0.5 % pectin.
- Then 400 g of the filtered date juice was poured into aluminum foil trays (15.5 × 11 × 4) smeared with few drops of paraffin oil.

- Each tray was dehydrated till the moisture content decreased to less than 16 % using oven at 50 °C for 72 hrs.
- The obtained date sheets were rolled in a cellophane paper and packaged in polyethylene bags till analysis.

Second: Production of TDS with Fiber:

- A portion of 300 g from each variety of the homogenized mixture of boiled date was poured in aluminum foil tray (15.5 x 11 x 4) smeared with few drops of paraffin oil.
- Each tray was dehydrated till the moisture content decreased to less than 16 % using Conventional oven at 50 °C for 40 hrs.
- The obtained date sheets were rolled in a cellophane paper and packaged in polyethylene bags till analysis

2.2. Preparation of Date Pudding samples:

- Date pudding was prepared using date juice from the five date varieties for each treatment.
- Water was added in the ratio of 1: 2 in case of date pudding using fresh date juice.
- Date pudding samples were prepared according to the method described by **Penfield and Campbell, (1990)** as following:
- Corn starch was mixed with cold water perfectly to product a suspension.
- Then fresh date juice was mixed with the suspension.
- The mixture was cooked over hot water bath at 90°C until it was thickened and come to a boil for 10-15 minutes approximately
- Then it was poured into cups and allowed to cool for 2 hrs at 4 °C.

2.3. Preparation of Date Jelly samples:

- Date jelly was prepared using date juice from the five date varieties for each treatment.
- Water was added in the ratio of 1: 2 in case of date jelly using fresh date juice.
- Date jelly samples were prepared according to the method described by **Penfield and Campbell, (1990)** as following:
- Gelatin was soaked in cold water for 5 minutes, and then fresh date juice (or date syrup) was added and stirred well.
- Then this mixture was heated over water bath at 80 °C until all gelatin powder was dissolved thoroughly.
- Then the mixture was poured into cups and cooled for 3 hrs at 4°C.

3. Chemical composition:

Ph, acidity, and total soluble solids (T.S.S.) were determined according to official methods of analysis (AOAC, 2005).

Color characteristics of fresh and dried dates products were performed using colorimeter (model: CR-410, Konica Minolta Sensing Americas, Inc., USA) according to the International Commission on Illumination (CIE) color coordinates L*, a* and b* (10° observer at D65 illuminant).

Mendoza *et al.,* (2006) also suggested that L*, a*, b* color system is the best color space for quantification in foods with curved surfaces. The L* value is used to denote lightness (100) and darkness (0), a* represents the tones between redness (+) and greenness (−), and b* denotes the tones between yellowness (+) and blueness (−). Prior to measurement, the meter was calibrated with a white standard tile provided by the manufacturer. Fresh and dried dates at three ripening stages were placed on the weighing boat to measure the color values. For each sample, measurements were replicated three to five times. Chroma, indicating color intensity, and hue angle were also calculated from the L*, a* and b* values as follows: Hue angle (H) = $tan^{-1}(b^*/a^*)$

The hue angle values vary from 0° (pure red color), 90° (pure yellow color), 180° (pure green color) to 270° (pure blue color) (Seerangurayar *et al.,* 2017).

Sensory evaluation of the Date products (Tamr-Elddin, pudding and jelly) was done after processing. Ten semi trained panelists were evaluated the samples using the numerical hedonic scale method. The panelist evaluated the sample for taste, color, odor, [(texture for Jelly and Pudding) or (degree of chewiness for Tamr-Elddin sheets)] and overall acceptability according to (Kulp *et al.,* 1980).

Statistical analysis was carried out using IBM SPSS Statistics 25, PC statistical software. LSD Multiple Range Test was applied to assess significant differences between means at 1% and 5% levels of probability (Steel *et al.,* 1997).

Results and Discussion:

1. Tamr-Elddin Date Sheets (TDS) without fiber:

There were no differences in total acidity (as malic acid) between all date products for all treatments, as shown in Table (1), and the total acidity ranged between (0.94 and 1.02 %) and the results indicated that all drying systems lied to increase the percent of total acidity for all fruit date varieties, whereas the highest total acidity was after solar drying while the lowest value was with mechanical drying system (oven). There were little differences in pH between Bartamuda and Gondaila, also, between Sakkoti and Shamia, generally the pH on fresh (Tamr) Aswan dry dates ranged between (5.44 and 6.31 %). Shamia and Bartamuda contained the highest T.S.S. (° Brix) by (86.76 and 86.33). It was found that the lightness (L), redness (a) and yellowness (b) values for T.D.S. without fiber samples were ranged from (17.18 – 20.15), (4.45 – 6.61) and from (1.02 – 2.30), respectively for T.D.S Without fiber from fresh dates. The obtained results were agreed with (Elghazali and Hussin, 1999) and (El-Sharnouby *et al.,* 2007). Analysis of variance for Physical evaluation of Tamr-Elddin without fiber prepared from the five date varieties of Aswan dry date, indicated that the date cultivars were highly significant affected ($p \leq 0.01$) for pH and acidity, while it did not significantly at ($P \leq 0.05$) for T.S.S. on the other hand there was highly significant affected ($p \leq 0.01$) between treatments for total acidity and T.S.S. but significantly at ($P \leq 0.05$) for pH and the interaction between treatments and date cultivars were significantly at ($P \leq 0.05$) for pH

while it did not significantly at ($P \leq 0.05$) for acidity and T.S.S.

With regard to overall acceptability of TDS in solar drying date, shown in Table (2) and Fig. (2), higher and lower significant scores at ($p < 0.05$) were found in Shamia and Malkabii (9.12 ± 1.53 and 4.84 ± 0.98, respectively). In case of mechanical drying date sheets, Sakkoti showed higher scores followed by Shamia (8.73 ± 1.39 and 8.46 ± 1.41 respectively) on the other hand we found the sun drying date sheet has a lower value compared to the other treatments. From the above-mentioned results, it could be concluded that Shamia (TDS) with fiber in solar drying had the best values for degree of chewiness, odor, color, and overall acceptability among all Tamr-Elddin Date Sheets (TDS) with fiber. But Sakkoti (TDS) with fiber in solar drying was the best compared to other date sheets regarding taste.

2. Tamr-Elddin Date Sheets (TDS) with fiber:

The results in Table (3) showed that Bartamuda contains the highest percent of total acidity by (1.04 %), while the Sakkoti contains the lowest percent of (0.90 %), also; Gondaila, Sakkoti, and Malkabii had lower pH values (4.53, 5.21 and 5.51; respectively). It could be noticed that slight differences were found in total soluble solids (T.S.S.) as °Brix between the different varieties in Tamr-Elddin Date Sheet (T.D.S.) with fiber. Where T.S.S. (° Brix) ranged from (69.17 – 74.40) for fresh (Tamr). We can say in generally the lightness (L), a (redness) and yellowness (b) values for T.D.S. with fiber samples from fresh dates were higher than T.D.S. with fiber samples from solar dried dates, followed by sun dried dates and mechanical dried dates. The obtained results were agreed with (Elghazali and Hussin, 1999) and (El-Sharnouby *et al.,* 2007). Analysis of variance for Physical evaluation of Tamr-Elddin with fiber prepared from the five date varieties of Aswan dry date, indicated that the date cultivars were highly significant affected ($p \leq 0.01$) for pH and acidity, while it did not significantly at ($P \leq 0.05$) for T.S.S. on the other hand there was highly significant affected ($p \leq 0.01$) between treatments for total acidity and T.S.S. but significantly at ($P \leq 0.05$) for pH and the interaction between treatments and date cultivars were highly significantly at ($P \leq 0.01$) for pH and T.S.S. while it did not significantly at ($P \leq 0.05$) for acidity.

Regarding overall acceptability of TDS in fresh date, shown in Table (4) and Fig. (3), higher and lower significant scores at ($p < 0.05$) were found in Shamia and Gondaila (7.17 ± 0.41 and 3.67 ± 0.19, respectively). In case of solar drying date sheets, Shamia showed higher scores followed by Sakkoti (7.23 ± 0.67 and 5.10 ± 0.64 respectively) on the other hand we found the sun drying date sheet has a lower value compared to the other treatments. From the above-mentioned results, it could be concluded that Shamia (TDS) without fiber in solar drying had the best values for degree of chewiness, odor, color, and overall acceptability among all Tamr-Elddin Date Sheets (TDS) without fiber. But Gondaila (TDS) without fiber in solar drying was the best compared to other date sheets regarding taste.

3. Date pudding:

The results in Table (5), indicated that total acidity (%) of puddings prepared from fresh date ranged from (0.22 - 0.29 %) which was found to be lower than those prepared from dried dates as well as little differences were found in pH values between budding samples; as they ranged from (5.41 to 6.40) for fresh (Tamr), and in generally the drying process led to decrease the pH values for all varieties. On the hand, T.S.S. (° Brix) of date pudding samples prepared varied between (13.14 to 18.93 ° Brix) for Malkabii and Bartamuda, respectively. The results indicated that the lightness (L) values for date Pudding samples from fresh dates were higher than date Pudding from solar dried dates, followed by sun dried dates and mechanical dried dates. The obtained results were agreed with (Elghazali and Hussin, 1999) and (El-Sharnouby *et al.,* 2007). Analysis of variance for physical evaluation of Date Pudding prepared from the five date varieties of Aswan dry date, indicated that the date cultivars were highly significant affected ($p \leq 0.01$) for pH, acidity and T.S.S. Also, there was highly significant affected ($p \leq 0.01$) between treatments for pH, total acidity and T.S.S. as well as the interaction between treatments and date cultivars were highly significantly at ($P \leq 0.01$) for pH and T.S.S. while it did not significantly at ($P \leq 0.05$) for acidity.

With regard to overall acceptability of Date Pudding in solar drying date, shown in Table (6) and Fig. (4), higher and lower significant scores at ($p < 0.05$) were found in Shamia and Malkabii (9.20 ± 0.65 and 5.63 ± 0.55, respectively). In case of mechanical drying Date Pudding, Shamia showed higher scores followed by Bartamuda (8.93 ± 0.67 and 7.53 ± 0.59 respectively) on the other hand we found the fresh Date Pudding has a lower value compared to the other treatments. From the above-mentioned results, it could be concluded that Shamia in solar drying had the best values for degree of chewiness, odor, taste, color, and overall acceptability among all Date Pudding.

4. Date jelly:

The results in Table (7), indicated that total acidity (%) of date jelly ranged from (0.24 – 0.31 %) for all samples, and the date jelly samples, prepared from fresh date, had the lowest values of pH values compared with that prepared from dried dated while T.S.S. (° Brix) of date jelly samples prepared from fresh date (20.75 – 27.11 ° Brix) were higher than those prepared from dried dates. The lightness (L) values for date Jelly samples from fresh dates were higher than date Jelly from solar dried dates, followed by sun dried dates and mechanical dried dates. The obtained results were agreed with (Elghazali and Hussin, 1999) and (El-Sharnouby *et al.,* 2007). Analysis of variance for physical evaluation of Date Jelly prepared from the five date varieties of Aswan dry date, indicated that the date cultivars were highly significant affected ($p \leq 0.01$) for pH, acidity and T.S.S. Also, there was highly significant affected ($p \leq 0.01$) between treatments for pH and T.S.S. while pH was significantly at ($P \leq 0.05$) as well as the interaction between treatments and date cultivars were highly significantly at ($P \leq 0.01$) for pH and T.S.S. while it did not significantly at ($P \leq 0.05$) for acidity.

About overall acceptability of Date Jelly in solar drying date, shown in Table (8) and Fig. (5), higher and lower significant scores at ($p < 0.05$) were found in Malkabii and Gondaila (8.82 ± 0.19 and 7.21 ± 0.39, respectively). In case of mechanical drying Date Jelly, Malkabii showed higher scores followed by Sakkoti (7.92 ± 0.61 and 7.14 ± 1.06 respectively) on the other hand we found the sun drying Date Jelly has a lower value compared to the other treatments. From the above-mentioned results, it could be concluded that Malkabii in solar drying had the best values for degree of chewiness, odor, color, and overall acceptability among all Date Jelly.

Table 1. Physical evaluation of Tamr-Elddin without fiber prepared from the five date varieties of Aswan dry date.

Date cultivars	Treatment	Acidity, (%)	pH	T.S.S., (° Brix)	Color			
					L(lightness)	a (redness)	b (yellowness)	Hue angle
Sakkoti	I	1.02 ± 0.02 ^{d}	6.31 ± 0.16 ^{a}	82.34 ± 0.67 ^{a}	20.61	4.95	1.54	17.22
	II	1.14 ± 0.03 ^{ab}	5.70 ± 0.10 ^{ad}	80.31 ± 1.73 ^{b}	19.36	3.62	1.36	20.81
	III	1.19 ± 0.02 ^{a}	6.28 ± 0.11 ^{ab}	79.67 ± 2.29 ^{c}	17.91	3.23	1.32	22.29
	IV	1.09 ± 0.01 ^{ac}	5.73 ± 0.07 ^{bc}	78.19 ± 0.97 ^{d}	18.45	4.65	0.98	11.86
Bartamuda	I	0.98 ± 0.01 ^{d}	5.47 ± 0.27 ^{c}	86.33 ± 1.75 ^{a}	25.65	5.64	1.14	11.31
	II	1.08 ± 0.02 ^{ab}	5.92 ± 0.11 ^{a}	80.77 ± 2.60 ^{c}	23.35	7.66	1.08	7.97
	III	1.13 ± 0.02 ^{a}	5.44 ± 0.10 ^{d}	81.03 ± 1.71 ^{b}	18.94	4.67	0.95	11.31
	IV	1.04 ± 0.02 ^{ac}	5.83 ± 0.15 ^{b}	77.60 ± 2.40 ^{ad}	21.36	3.68	1.02	15.64
Gondaila	I	0.96 ± 0.03 ^{ad}	5.44 ± 0.10 ^{b}	83.72 ± 2.41 ^{a}	20.18	6.61	2.01	16.7
	II	1.03 ± 0.02 ^{ab}	5.36 ± 0.12 ^{c}	81.72 ± 1.03 ^{b}	19.15	4.52	1.98	23.75
	III	1.08 ± 0.01 ^{a}	5.31 ± 0.11 ^{abcd}	80.47 ± 0.52 ^{c}	17.25	7.96	1.09	7.97
	IV	1.00 ± 0.02 ^{ac}	4.77 ± 0.54 ^{a}	79.58 ± 1.14 ^{d}	18.60	3.60	1.67	24.7
Malkabii	I	0.94 ± 0.01 ^{d}	5.84 ± 0.14 ^{a}	81.66 ± 1.57 ^{a}	18.65	6.54	3.05	25.17
	II	1.02 ± 0.02 ^{ab}	5.39 ± 0.08 ^{c}	77.72 ± 2.31 ^{d}	19.23	4.69	2.30	26.1
	III	1.06 ± 0.02 ^{a}	5.63 ± 0.09 ^{b}	79.05 ± 1.70 ^{b}	18.95	7.62	1.35	10.2
	IV	0.99 ± 0.01 ^{c}	5.36 ± 0.09 ^{d}	78.34 ± 1.20 ^{c}	16.54	2.81	1.90	34.21
Shamia	I	0.95 ± 0.01 ^{d}	6.21 ± 0.11 ^{b}	86.76 ± 2.54 ^{a}	27.15	4.45	1.38	17.22
	II	1.03 ± 0.02 ^{b}	6.27 ± 0.10 ^{a}	81.02 ± 1.15 ^{b}	24.37	7.75	1.45	10.76
	III	1.07 ± 0.02 ^{a}	6.01 ± 0.05 ^{c}	78.27 ± 1.85 ^{ac}	20.78	4.25	1.06	14.01
	IV	0.99 ± 0.01 ^{ac}	5.97 ± 0.17 ^{d}	77.50 ± 1.12 ^{ad}	22.65	3.52	1.27	19.8

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at $p \leq 0.05$ using one-way ANOVA test, while those with similar letters are not significant by different.

Table 2. Organoleptic characteristics of Tamr-Elddin Date Sheets (TDS) without fiber.

Date cultivars	Treatment	Degree of chawing	Odor	Taste	Color	Overall acceptability
Malkabii	**I**	4.10 ± 1.15 [b]	4.04 ± 1.15 [b]	5.78 ± 0.69 [c]	3.50 ± 1.32 [a]	5.33 ± 0.57 [a]
	II	4.13 ± 1.20 [a]	4.33 ± 0.07 [a]	6.17 ± 1.67 [a]	3.10 ± 0.86 [b]	4.67 ± 0.37 [c]
	III	3.11 ± 1.16 [d]	3.83 ± 1.04 [d]	5.26 ± 1.04 [d]	2.67 ± 1.08 [d]	4.06 ± 1.09 [d]
	IV	3.44 ± 0.70 [c]	3.99 ± 1.31 [c]	6.04 ± 0.29 [b]	2.90 ± 0.76 [c]	4.83 ± 0.64 [b]
Gondaila	**I**	4.50 ± 0.32 [a]	2.96 ± 0.83 [d]	6.17 ± 0.76 [b]	2.33 ± 1.15 [c]	3.67 ± 0.19 [a]
	II	4.50 ± 0.09 [a]	3.83 ± 0.87 [a]	6.33 ± 0.58 [a]	2.83 ± 1.04 [a]	3.50 ± 0.27 [b]
	III	3.67 ± 0.86 [c]	3.41 ± 0.76 [c]	5.37 ± 0.42 [d]	2.17 ± 0.72 [d]	3.17 ± 0.32 [d]
	IV	4.11 ± 1.08 [b]	3.61 ± 1.23 [b]	5.67 ± 0.54 [c]	2.67 ± 1.52 [b]	3.33 ± 0.29 [c]
Sakkoti	**I**	4.17 ± 0.61 [c]	5.33 ± 0.58 [a]	5.46 ± 1.50 [a]	4.17 ± 1.25 [c]	4.67 ± 0.51 [b]
	II	5.10 ± 0.73 [a]	4.83 ± 0.77 [c]	5.33 ± 1.89 [b]	4.54 ± 0.44 [a]	5.10 ± 0.64 [a]
	III	3.83 ± 1.11 [d]	4.26 ± 0.58 [d]	4.64 ± 1.08 [d]	3.17 ± 0.89 [d]	3.50 ± 0.76 [b]
	IV	4.83 ± 0.81 [b]	5.33 ± 0.89 [a]	5.12 ±1.51 [c]	4.47 ± 1.16 [b]	4.61 ± 0.50 [c]
Shamia	**I**	5.17 ± 0.59 [c]	6.50 ± 1.32 [a]	6.67 ± 0.57 [a]	6.67 ± 0.57 [d]	7.17 ± 0.41 [a]
	II	5.67 ± 0.76 [a]	6.04 ± 1.01 [b]	5.20 ± 1.21 [c]	7.67 ± 0.34 [a]	7.23 ± 0.67 [b]
	III	4.33 ± 0.52 [d]	5.03 ± 1.16 [c]	5.67 ± 1.15 [b]	7.04 ± 0.61 [c]	6.67 ± 0.40 [d]
	IV	5.33 ± 0.16 [b]	5.26 ± 0.92 [d]	4.33 ± 1.51 [d]	7.33 ± 1.05 [b]	7.03 ± 1.01 [c]
Bartamuda	**I**	3.67 ± 0.13 [a]	3.30 ± 0.52 [a]	4.50 ± 0.86 [b]	5.05 ± 1.07 [a]	4.03 ± 0.17 [a]
	II	3.33 ± 0.57 [b]	3.33 ± 1.25 [b]	4.67 ± 0.64 [a]	4.50 ± 1.01 [b]	3.92 ± 1.04 [b]
	III	2.17 ± 0.30 [d]	3.13 ± 1.12 [c]	4.33 ± 0.91 [c]	4.10 ± 0.50 [d]	3.50 ± 0.37 [d]
	IV	2.67 ± 0.67 [c]	3.11 ± 0.21 [d]	3.67 ± 0.43 [d]	4.15 ± 0.73 [c]	3.81 ± 0.49 [c]

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 3. Physical evaluation of Tamr-Elddin with fiber prepared from the five date varieties of Aswan dry date.

Date cultivars	Treatment	Acidity, (%)	pH	T.S.S. (° Brix)	Color			
					L (lightness)	A (redness)	B (yellowness)	Hue angel
Sakkoti	**I**	0.90 ± 0.04 [abcd]	5.21 ± 0.47 [c]	71.17 ± 1.47 [a]	18.53	2.02	1.87	42.79
	II	1.23 ± 0.06 [ab]	5.49 ± 0.28 [a]	68.70 ± 1.04 [b]	20.63	6.17	1.73	15.64
	III	1.39 ± 0.05 [a]	5.16 ± 0.33 [d]	67.73 ± 1.09 [c]	22.13	4.85	1.64	18.78
	IV	1.06 ± 0.02 [abc]	5.47 ± 0.18 [b]	66.64 ± 1.77 [d]	20.48	7.62	1.18	8.53
Bartamuda	**I**	1.04 ± 0.03 [abc]	6.26 ± 0.18 [a]	74.40 ± 1.65 [a]	20.38	1.00	2.92	71.10
	II	1.09 ± 0.06 [b]	6.03 ± 0.33 [b]	68.03 ± 2.75 [c]	22.84	7.43	2.76	20.30
	III	1.23 ± 0.04 [a]	5.58 ± 0.34 [d]	69.10 ± 1.64 [b]	21.35	3.65	1.94	27.92
	IV	0.98 ± 0.05 [bcd]	5.74 ± 0.39 [ac]	64.93 ± 2.63 [ac]	10.54	4.67	2.34	26.57
Gondaila	**I**	0.95 ± 0.03 [d]	4.53 ± 0.29 [ad]	72.83 ± 2.10 [a]	15.72	8.25	5.48	33.42
	II	0.96 ± 0.06 [c]	5.32 ± 0.39 [ab]	70.33 ± 2.05 [b]	21.03	5.84	5.32	42.30
	III	1.10 ± 0.04 [a]	5.12 ± 0.17 [ac]	69.53 ± 2.03 [c]	20.84	7.23	4.35	30.96
	IV	1.04 ± 0.09 [ab]	5.44 ± 0.29 [a]	67.67 ± 2.13 [d]	19.64	6.45	4.36	34.22
Malkabii	**I**	0.94 ± 0.03 [abcd]	5.51 ± 0.44 [a]	69.17 ± 3.65 [a]	13.54	1.47	1.10	36.08
	II	1.18 ± 0.04 [a]	5.16 ± 0.30 [b]	67.77 ± 2.31 [b]	11.42	4.67	1.09	12.95
	III	1.06 ± 0.04 [abc]	4.91 ± 0.14 [d]	67.45 ± 1.01 [c]	9.34	3.65	1.12	17.22
	IV	1.08 ± 0.03 [ab]	5.08 ± 0.26 [ac]	70.17 ± 3.35 [d]	11.36	5.12	0.97	10.76
Shamia	**I**	0.99 ± 0.02 [b]	5.67 ± 0.16 [ad]	74.40 ± 1.56 [a]	21.08	1.41	7.56	79.44
	II	0.93 ± 0.04 [bc]	6.21 ± 0.34 [ac]	71.30 ± 0.96 [b]	26.85	10.75	6.94	33.02
	III	1.03 ± 0.04 [a]	6.43 ± 0.15 [a]	68.27 ± 1.87 [c]	21.58	8.21	5.43	33.42
	IV	0.81 ± 0.03 [abd]	6.26 ± 0.51 [b]	65.97 ± 1.53 [ac]	20.34	7.64	5.67	36.50

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 4. Organoleptic characteristics of Tamr-Elddin Date Sheets (TDS) with fiber.

Date cultivars	Treatment	Degree of chewing	Odor	Taste	Color	Overall acceptability
Malkabii	I	4.33 ± 0.85 ^{c}	5.58 ± 1.34 ^{c}	6.46 ± 0.89 ^{b}	4.44 ± 0.28 ^{b}	4.84 ± 0.98 ^{b}
	II	5.11 ± 1.52 ^{a}	6.03 ± 1.06 ^{a}	6.61 ± 0.56 ^{a}	4.52 ± 0.50 ^{a}	5.36 ± 0.51 ^{a}
	III	4.03 ± 0.95 ^{d}	5.26 ± 0.71 ^{d}	6.06 ± 0.34 ^{d}	4.04 ± 0.85 ^{d}	4.63 ± 0.58 ^{d}
	IV	4.67 ± 0.53 ^{b}	5.67 ± 0.83 ^{b}	6.17 ± 0.97 ^{c}	4.22 ± 0.98 ^{c}	4.76 ± 0.92 ^{c}
Gondaila	I	6.22 ± 1.07 ^{b}	6.06 ± 0.72 ^{a}	6.71 ± 1.10 ^{b}	5.93 ± 1.19 ^{b}	5.98 ± 0.95 ^{b}
	II	6.30 ± 1.12 ^{a}	5.83 ± 0.58 ^{c}	7.26 ± 0.84 ^{a}	6.32 ± 1.43 ^{a}	6.33 ± 0.85 ^{a}
	III	5.10 ± 1.01 ^{d}	5.53 ± 0.96 ^{d}	6.38 ± 0.31 ^{d}	5.85 ± 1.34 ^{c}	5.71 ± 0.47 ^{d}
	IV	5.67 ± 0.58 ^{c}	5.92 ± 0.83 ^{b}	6.48 ± 0.76 ^{c}	5.62 ± 0.80 ^{d}	5.90 ± 0.82 ^{c}
Sakkoti	I	8.82 ± 1.08 ^{b}	8.42 ± 0.94 ^{c}	8.85 ± 0.80 ^{b}	9.21 ± 2.50 ^{b}	9.01 ± 1.60 ^{b}
	II	8.95 ± 1.16 ^{a}	8.74 ± 1.06 ^{a}	9.18 ± 0.49 ^{a}	9.30 ± 1.58 ^{a}	9.05 ± 1.25 ^{a}
	III	8.08 ± 0.32 ^{d}	8.27 ± 0.90 ^{d}	8.36 ± 0.69 ^{c}	8.84 ± 1.86 ^{c}	8.71 ± 1.77 ^{d}
	IV	8.42 ± 0.88 ^{c}	8.45 ± 0.41 ^{b}	8.32 ± 0.48 ^{d}	8.83 ± 1.62 ^{d}	8.73 ± 1.39 ^{c}
Shamia	I	9.17 ± 0.52 ^{b}	8.54 ± 0.85 ^{c}	8.89 ± 0.25 ^{b}	9.51 ± 1.74 ^{a}	9.11 ± 1.25 ^{b}
	II	9.33 ± 0.29 ^{a}	9.08 ± 1.08 ^{a}	9.02 ± 0.31 ^{a}	9.47 ± 0.57 ^{b}	9.12 ± 1.53 ^{a}
	III	8.13 ± 0.23 ^{abd}	8.53 ± 0.69 ^{d}	8.38 ± 1.21 ^{d}	8.85 ± 1.20 ^{d}	8.77 ± 1.17 ^{c}
	IV	8.43 ± 0.51 ^{abc}	8.61 ± 0.73 ^{b}	8.40 ± 1.09 ^{c}	9.10 ± 1.48 ^{c}	8.46 ± 1.41 ^{d}
Bartamuda	I	7.80 ± 1.15 ^{c}	8.83 ± 1.01 ^{a}	8.11 ± 1.39 ^{c}	8.53 ± 1.39 ^{b}	8.38 ± 1.14 ^{b}
	II	8.33 ± 0.34 ^{a}	8.45 ± 0.89 ^{d}	8.71 ± 1.27 ^{a}	8.68 ± 0.89 ^{a}	8.67 ± 1.09 ^{a}
	III	7.77 ± 0.41 ^{d}	7.69 ± 0.28 ^{b}	7.92 ± 0.98 ^{d}	8.03 ± 1.07 ^{d}	7.76 ± 1.42 ^{d}
	IV	7.90 ± 1.10 ^{b}	8.48 ± 0.36 ^{c}	8.12 ± 0.77 ^{b}	8.23 ± 0.67 ^{c}	8.06 ± 0.93 ^{c}

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 5. Physical evaluation of Date pudding prepared from the five date varieties of Aswan dry date.

Date cultivars	Treatment	Acidity, (%)	pH	T.S.S. (° Brix)	Color			
					L (lightness)	a (redness)	b (yellowness)	Hue angle
Sakkoti	I	0.29 ± 0.01 ^{acd}	6.29 ± 0.16 ^{b}	13.16 ± 0.39 ^{a}	38.84	0.80	9.24	85.05
	II	0.41 ± 0.03 ^{ab}	5.78 ± 0.09 ^{c}	11.82 ± 0.04 ^{b}	32.15	2.15	8.45	75.72
	III	0.45 ± 0.20 ^{a}	6.34 ± 0.11 ^{a}	11.20 ± 0.01 ^{ac}	39.04	0.20	2.46	85.35
	IV	0.37 ± 0.01 ^{ac}	5.77 ± 0.05 ^{d}	10.57 ± 0.01 ^{ad}	29.46	1.12	4.51	76.06
Bartamuda	I	0.26 ± 0.01 ^{acd}	6.40 ± 0.22 ^{a}	18.93 ± 0.31 ^{a}	40.06	1.30	9.63	82.31
	II	0.36 ± 0.02 ^{ab}	5.93 ± 0.11 ^{b}	16.17 ± 0.08 ^{ab}	38.74	1.52	7.25	78.16
	III	0.41 ± 0.02 ^{a}	5.49 ± 0.11 ^{d}	12.68 ± 0.03 ^{abc}	39.28	0.60	4.40	82.23
	IV	0.32 ± 0.02 ^{abc}	5.83 ± 0.14 ^{ac}	11.78 ± 0.54 ^{abd}	42.49	1.77	6.85	75.51
Gondaila	I	0.25 ± 0.01 ^{acd}	5.41 ± 0.09 ^{a}	14.63 ± 0.45 ^{a}	35.38	0.32	7.68	87.61
	II	0.34 ± 0.02 ^{ab}	5.38 ± 0.14 ^{c}	13.53 ± 0.08 ^{b}	32.46	0.94	7.61	82.96
	III	0.39 ± 0.02 ^{a}	5.40 ± 0.11 ^{b}	13.19 ± 0.11 ^{c}	29.36	1.06	6.36	80.53
	IV	0.31 ± 0.01 ^{abc}	4.77 ± 0.54 ^{d}	12.95 ± 0.03 ^{d}	31.88	0.39	7.35	86.96
Malkabii	I	0.24 ± 0.01 ^{acd}	6.13 ± 0.16 ^{a}	13.14 ± 0.76 ^{a}	25.84	2.04	5.27	68.81
	II	0.33 ± 0.02 ^{ab}	5.70 ± 0.11 ^{c}	11.07 ± 0.02 ^{ab}	22.51	1.97	4.67	67.12
	III	0.37 ± 0.01 ^{a}	5.98 ± 0.04 ^{b}	10.69 ± 0.02 ^{ac}	18.50	2.02	2.98	55.95
	IV	0.29 ± 0.01 ^{ac}	5.66 ± 0.09 ^{d}	9.89 ± 0.07 ^{ad}	20.15	1.88	3.48	61.61
Shamia	I	0.22 ± 0.01 ^{acd}	5.98 ± 0.09 ^{b}	15.75 ± 0.33 ^{a}	43.22	0.20	5.83	29.15
	II	0.31 ± 0.02 ^{ab}	6.07 ± 0.11 ^{a}	13.37 ± 0.02 ^{ab}	40.84	0.67	4.91	82.23
	III	0.35 ± 0.02 ^{a}	5.85 ± 0.05 ^{c}	12.41 ± 0.05 ^{ac}	35.95	0.34	3.38	84.25
	IV	0.27 ± 0.02 ^{ac}	5.77 ± 0.16 ^{d}	9.54 ± 0.06 ^{acd}	37.26	0.19	4.47	87.57

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 6. Organoleptic characteristics of Date Pudding.

Date culti-vars	Treat-ment	Texture	Odor	Taste	Color	Overall accept-ability
Malkabii	I	6.00 ± 0.47 ^{c}	6.13 ± 0.51 ^{c}	6.39 ± 0.94 ^{a}	5.21 ± 0.61 ^{b}	5.19 ± 0.70 ^{ac}
	II	6.33 ± 0.16 ^{a}	6.53 ± 0.76 ^{a}	6.42 ± 0.85 ^{b}	5.52 ± 0.50 ^{a}	5.63 ± 0.55 ^{a}
	III	5.67 ± 0.31 ^{ad}	6.07 ± 0.13 ^{ad}	6.03 ± 0.54 ^{d}	5.14 ± 0.22 ^{abcd}	5.16 ± 0.29 ^{d}
	IV	6.31 ± 0.81 ^{ab}	6.27 ± 0.43 ^{b}	6.07 ± 0.15 ^{c}	5.17 ± 0.85 ^{c}	5.28 ± 0.93 ^{b}
Gondaila	I	6.00 ± 0.50 ^{d}	6.53 ± 0.86 ^{ad}	6.42 ± 0.86 ^{ad}	5.83 ± 0.57 ^{d}	5.81 ± 0.62 ^{d}
	II	7.00 ± 0.19 ^{a}	7.20 ± 0.75 ^{a}	6.94 ± 0.37 ^{a}	6.23 ± 0.09 ^{a}	6.29 ± 0.11 ^{a}
	III	6.33 ± 0.94 ^{c}	6.60 ± 0.11 ^{c}	6.69 ± 0.27 ^{b}	5.91 ± 1.01 ^{c}	5.87 ± 0.09 ^{ac}
	IV	6.67 ± 0.80 ^{b}	6.87 ± 0.64 ^{b}	6.47 ± 0.14 ^{c}	5.96 ± 0.86 ^{ab}	6.10 ± 0.89 ^{b}
Shamia	I	8.67 ± 0.17 ^{b}	8.27 ± 0.11 ^{c}	8.11 ± 0.86 ^{d}	8.51 ± 0.58 ^{abd}	8.39 ± 0.30 ^{cd}
	II	9.00 ± 0.13 ^{a}	9.20 ± 1.07 ^{a}	8.94 ± 0.53 ^{a}	9.23 ± 0.25 ^{a}	9.20 ± 0.65 ^{a}
	III	7.67 ± 0.83 ^{d}	8.27 ± 0.67 ^{c}	8.21 ± 0.43 ^{c}	8.56 ± 0.16 ^{c}	8.49 ± 0.71 ^{c}
	IV	8.47 ± 0.67 ^{c}	8.87 ± 0.49 ^{b}	8.75 ± 0.11 ^{b}	9.18 ± 0.83 ^{b}	8.93 ± 0.67 ^{b}
Sakkoti	I	7.00 ± 0.33 ^{ac}	6.93 ± 0.24 ^{abd}	6.88± 0.84 ^{c}	7.06 ± 0.57 ^{c}	6.92 ± 0.54 ^{d}
	II	7.67 ± 0.61 ^{a}	7.27 ± 0.89 ^{a}	7.35 ± 0.67 ^{a}	7.35 ± 0.37 ^{a}	7.35 ± 0.41 ^{a}
	III	6.67 ± 0.90 ^{d}	7.07 ± 0.09 ^{c}	6.84 ± 0.61 ^{abd}	6.92 ± 0.90 ^{d}	6.93 ± 0.80 ^{c}
	IV	7.33 ± 0.61 ^{b}	7.20 ± 0.83 ^{b}	6.94 ± 0.85 ^{b}	7.12 ± 0.81 ^{b}	7.06 ± 0.53 ^{b}
Bar-tamuda	I	7.33 ± 0.37 ^{b}	7.40 ± 0.64 ^{ac}	7.31 ± 0.36 ^{c}	7.32 ± 0.64 ^{c}	7.14 ± 0.49 ^{d}
	II	7.67 ± 0.82 ^{a}	7.93 ± 0.44 ^{a}	7.73 ± 0.53 ^{a}	7.83 ± 0.91 ^{a}	7.86 ± 0.60 ^{a}
	III	6.67 ± 0.69 ^{d}	7.27 ± 0.79 ^{d}	7.07 ± 0.81 ^{ad}	7.28 ± 0.61 ^{abd}	7.15 ± 0.72 ^{c}
	IV	7.00 ± 0.80 ^{c}	7.67 ± 0.56 ^{b}	7.67 ± 0.49 ^{b}	7.56 ± 0.49 ^{ab}	7.53 ± 0.59 ^{ab}

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 7. Physical evaluation of Date Jelly prepared from the five date varieties of Aswan dry date.

Date culti-vars	Treatment	Acidity, (%)	pH	T.S.S. (° Brix)	Color			
					L (light-ness)	a (red-ness)	b (yellow-ness)	Hue angle
Sakkoti	I	0.31 ± 0.02 ^{abd}	6.19 ± 0.15 ^{b}	22.12 ± 0.02 ^{a}	30.59	10.90	13.12	50.19
	II	0.44 ± 0.03 ^{ab}	5.66 ± 0.09 ^{c}	17.25 ± 0.02 ^{ab}	27.17	11.17	11.10	44.71
	III	0.50 ± 0.02 ^{a}	6.21 ± 0.11 ^{a}	15.69 ± 0.05 ^{ac}	27.26	11.95	9.33	37.95
	IV	0.39 ± 0.02 ^{abc}	5.62 ± 0.10 ^{d}	14.56 ± 0.64 ^{abd}	26.84	10.69	8.32	37.95
Bar-tamuda	I	0.27 ± 0.01 ^{acd}	4.90 ± 2.21 ^{ad}	20.75 ± 0.06 ^{a}	40.50	10.85	9.49	41.02
	II	0.38 ± 0.03 ^{ab}	5.83 ± 0.11 ^{a}	15.57 ± 0.05 ^{ab}	37.16	8.00	6.44	39.01
	III	0.44 ± 0.02 ^{a}	5.37 ± 0.12 ^{c}	14.46 ± 0.53 ^{abc}	30.01	12.38	7.99	33.02
	IV	0.34 ± 0.02 ^{abc}	5.73 ± 0.14 ^{ab}	12.26 ± 0.04 ^{abcd}	30.55	8.26	4.70	29.68
Gondaila	I	0.26 ± 0.01 ^{acd}	5.31 ± 0.10 ^{a}	27.11 ± 0.32 ^{a}	37.11	11.27	11.48	45.57
	II	0.36 ± 0.03 ^{ab}	5.26 ± 0.13 ^{c}	22.24 ± 0.20 ^{ab}	35.95	8.70	5.62	33.02
	III	0.42 ± 0.02 ^{a}	5.28 ± 0.11 ^{b}	16.86 ± 0.34 ^{ac}	28.88	8.52	4.56	28.37
	IV	0.32 ± 0.02 ^{abc}	4.68 ± 0.55 ^{d}	13.42 ± 0.03 ^{ad}	30.50	7.12	2.50	19.29
Malkabii	I	0.25 ± 0.01 ^{acd}	6.05 ± 0.15 ^{a}	23.30 ± 0.06 ^{a}	17.13	10.19	2.79	15.11
	II	0.35 ± 0.02 ^{ab}	5.60 ± 0.10 ^{c}	18.13 ± 0.05 ^{ab}	24.77	9.92	2.58	14.57
	III	0.40 ± 0.02 ^{a}	5.87 ± 0.05 ^{b}	16.68 ± 0.06 ^{ac}	22.67	5.54	0.95	9.65
	IV	0.31 ± 0.02 ^{abc}	5.56 ± 0.10 ^{d}	15.85 ± 0.21 ^{ad}	23.59	7.52	1.52	11.31
Shamia	I	0.24 ± 0.02 ^{cd}	5.89 ± 0.10 ^{b}	26.47 ± 0.06 ^{a}	45.19	14.74	15.02	45.56
	II	0.32 ± 0.02 ^{ab}	5.98 ± 0.10 ^{a}	17.03 ± 0.02 ^{ac}	42.48	12.64	15.62	51.11
	III	0.37 ± 0.02 ^{a}	5.74 ± 0.04 ^{c}	17.86 ± 0.45 ^{ab}	37.51	14.52	14.28	44.42
	IV	0.28 ± 0.02 ^{abc}	5.66 ± 0.16 ^{d}	13.95 ± 0.03 ^{abcd}	39.69	15.23	13.54	41.67

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at p≤0.05 using one-way ANOVA test, while those with similar letters are not significant by different.

Table 8. Organoleptic characteristics of Date Jelly.

Date culti-vars	Treatment	Texture	Odor	Taste	Color	Overall ac-ceptability
Malkabii	**I**	7.33 ± 0.14 ^{ad}	7.33 ± 0.47 ^{abcd}	7.67 ± 0.40 ^{abd}	7.13 ± 0.52 ^{abd}	7.28 ± 0.50 ^{d}
	II	8.90 ± 0.94 ^{a}	8.67 ± 0.51 ^{a}	8.57 ± 0.45 ^{a}	8.27 ± 0.32 ^{a}	8.82 ± 0.19 ^{a}
	III	7.38 ± 0.82 ^{ac}	8.07 ± 0.09 ^{c}	8.50 ± 0.19 ^{b}	7.67 ± 0.47 ^{c}	7.92 ± 0.61 ^{c}
	IV	8.00 ± 0.94 ^{b}	8.33 ± 0.42 ^{b}	8.13 ± 0.35 ^{c}	8.23 ± 0.19 ^{b}	8.06 ± 0.69 ^{b}
Gondaila	**I**	5.87 ± 0.82 ^{d}	6.33 ± 0.32 ^{abc}	6.07± 0.63 ^{abd}	7.14 ± 0.61^{d}	6.72 ± 0.91 ^{d}
	II	6.83 ± 0.85 ^{a}	7.70 ± 0.49 ^{a}	7.40 ± 0.70 ^{a}	7.82 ± 0.58 ^{b}	7.21 ± 0.39 ^{a}
	III	6.02 ± 0.47 ^{c}	6.67 ± 0.05 ^{ac}	6.33 ± 0.19 ^{abc}	7.79 ± 0.99 ^{c}	7.04 ± 0.51 ^{c}
	IV	6.67 ± 0.19 ^{b}	7.03 ± 0.47 ^{ab}	7.27 ± 0.28 ^{b}	7.89 ± 0.67 ^{a}	7.20 ± 0.64 ^{b}
Shamia	**I**	6.13 ± 1.03 ^{d}	6.67 ± 0.43 ^{d}	6.71 ± 1.25 ^{d}	6.33 ± 0.78 ^{d}	6.58 ± 0.45 ^{a}
	II	7.17 ± 0.98 ^{a}	7.60 ± 0.82 ^{a}	7.33 ± 0.61 ^{a}	7.97 ± 0.42 ^{a}	7.49 ± 0.37 ^{b}
	III	6.33 ± 0.94 ^{c}	6.93 ± 0.24 ^{c}	6.83 ± 0.37 ^{c}	7.33 ± 0.39 ^{b}	6.77 ± 0.84 ^{d}
	IV	6.67 ± 0.47 ^{b}	7.17 ± 0.94 ^{b}	7.11 ± 0.53 ^{b}	7.08 ± 0.72 ^{abc}	6.83 ± 0.16 ^{c}
Sakkoti	**I**	6.00 ± 0.47 ^{d}	6.67 ± 0.69 ^{ad}	6.67 ± 1.02 ^{d}	7.09 ± 0.91 ^{d}	6.77 ± 0.51 ^{a}
	II	7.33 ± 1.24 ^{a}	8.10 ± 0.78 ^{a}	7.43 ± 0.82 ^{a}	7.73 ± 1.09 ^{a}	7.43 ± 0.37 ^{b}
	III	6.33 ± 0.56 ^{c}	7.03 ± 0.42 ^{c}	6.75 ± 0.74 ^{c}	7.48 ± 0.83 ^{c}	7.14 ± 1.06 ^{d}
	IV	7.23 ± 1.63 ^{b}	7.43 ± 0.95 ^{b}	7.03 ± 0.52 ^{b}	7.54 ± 0.42 ^{b}	7.37 ± 0.88 ^{c}
Bartamuda	**I**	6.50 ± 0.47 ^{d}	6.67 ± 0.43 ^{d}	6.33 ± 0.36 ^{d}	8.10 ± 0.86 ^{a}	6.59 ± 0.30 ^{d}
	II	7.33 ± 0.71 ^{a}	7.33 ± 0.92 ^{b}	7.67 ± 1.09 ^{a}	7.04 ± 0.42 ^{d}	7.26 ± 0.97 ^{a}
	III	6.67 ± 0.94 ^{c}	7.00 ± 0.65 ^{c}	6.83 ± 0.30 ^{c}	7.30 ± 0.52 ^{c}	6.78 ± 1.12 ^{c}
	IV	6.83 ± 0.63 ^{b}	7.47 ± 0.47 ^{a}	7.03 ± 0.89 ^{b}	7.37 ± 0.94 ^{b}	7.08 ± 0.81 ^{b}

I = Fresh (Tamr), II = Solar Drying, III= Sun Drying, IV= Mechanical Drying (Oven). Means with different letters (a, b, c, d) in the same column different significantly at $p \leq 0.05$ using one-way ANOVA test, while those with similar letters are not significant by different.

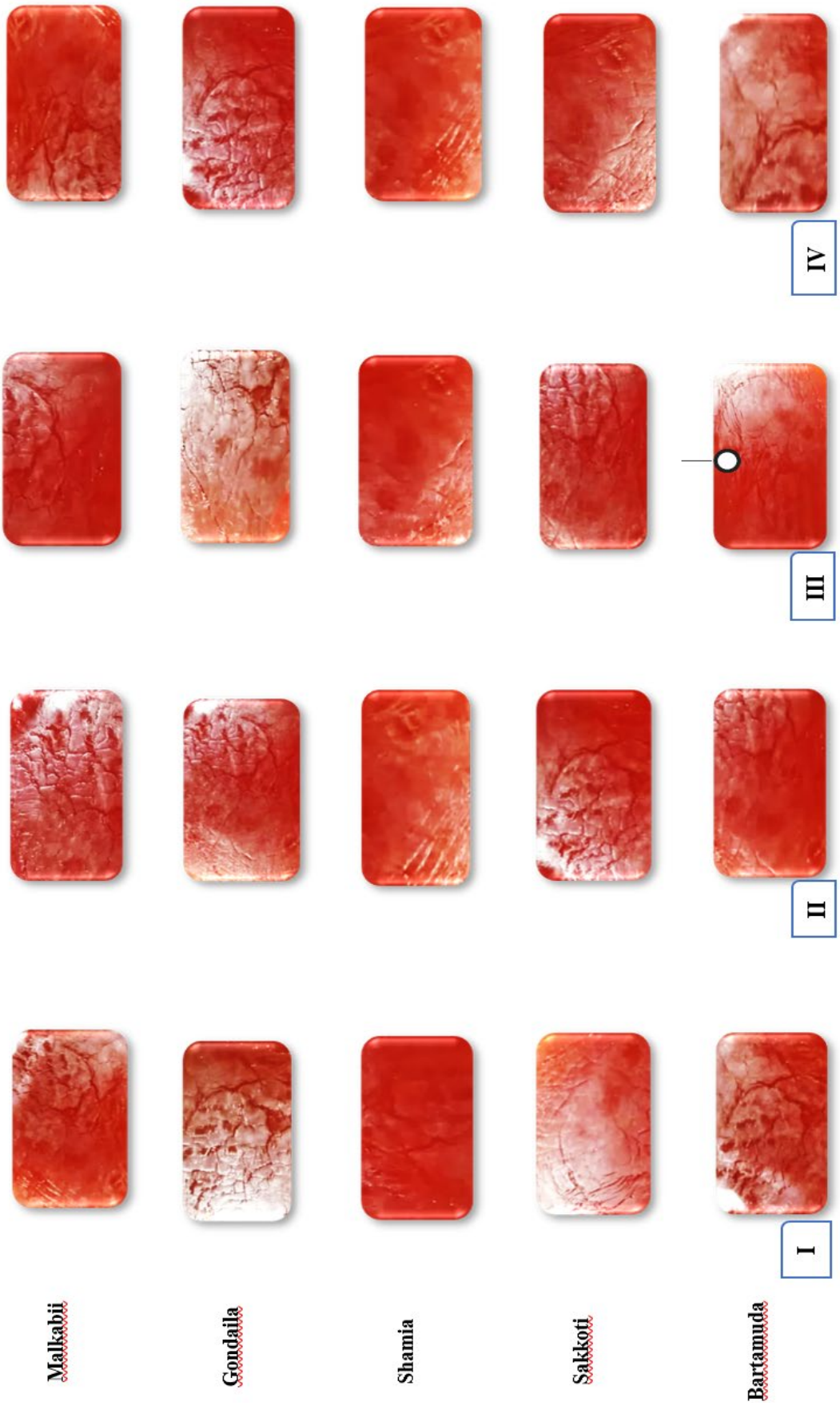

Fig. 2: Photography of Tamr-Elddin Date Sheet (T.D.S.) without fiber

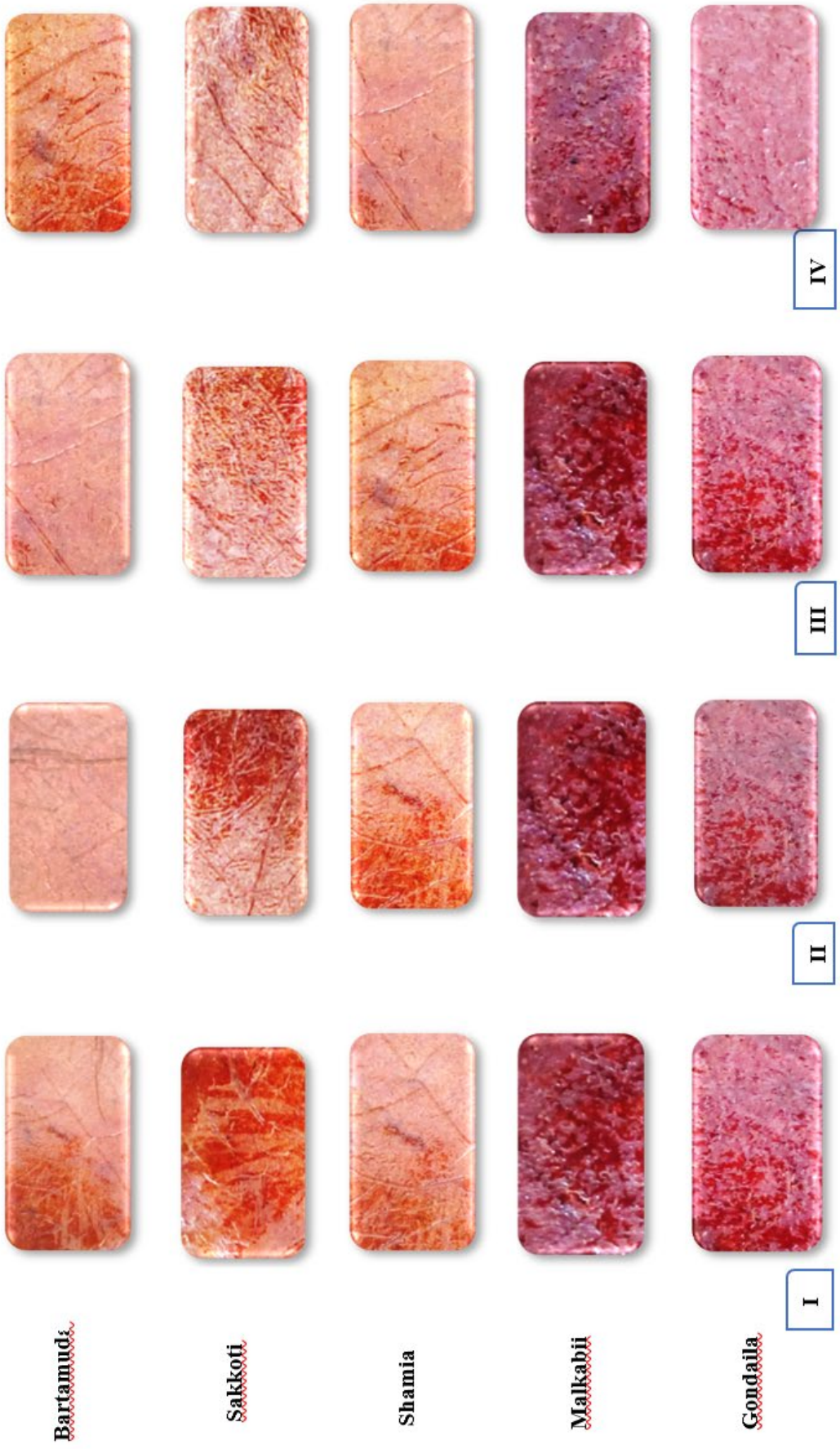

Fig. 3: Photography of Tamr-Elddin Date Sheet (T.D.S.) with fiber.

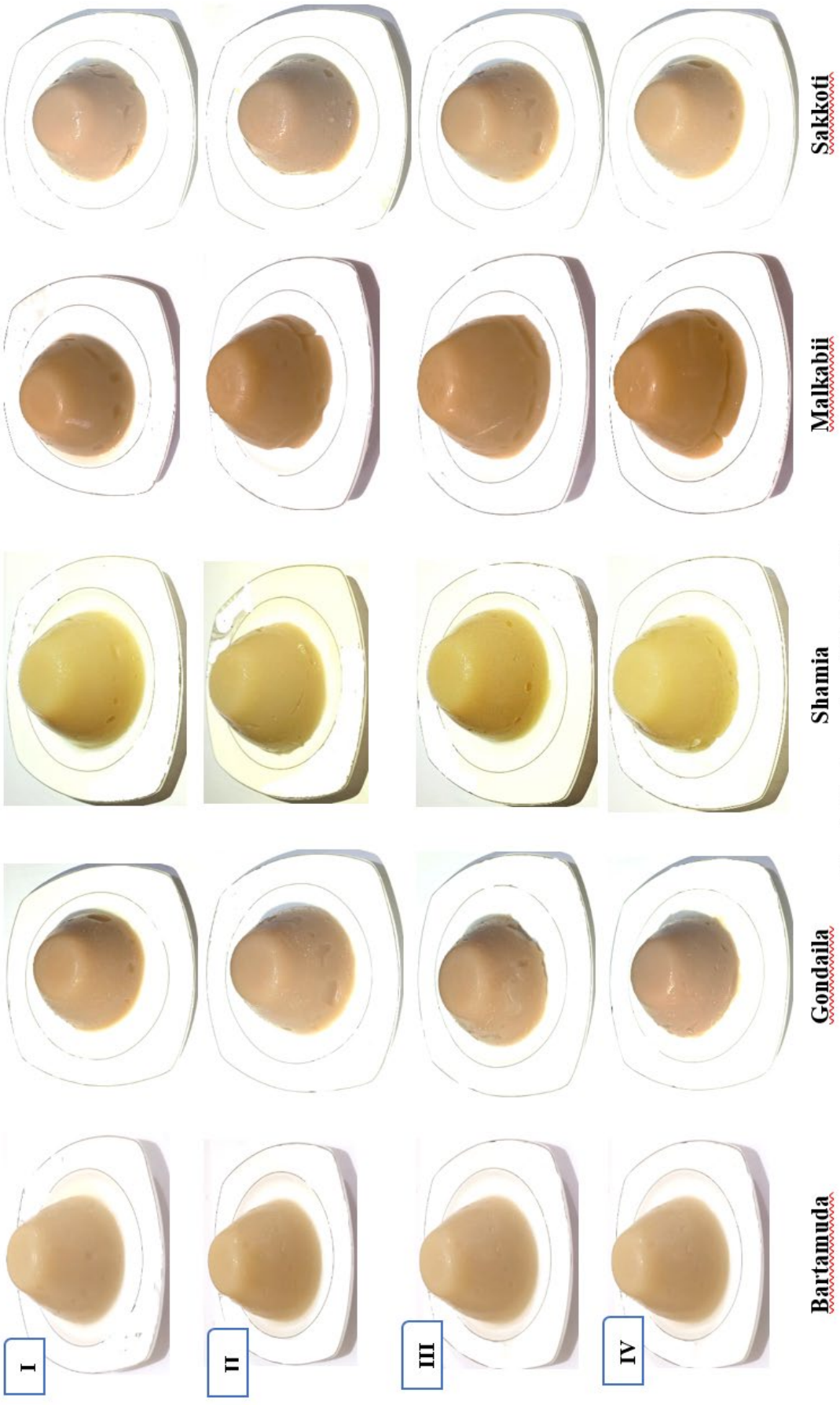

Fig. 4: Photography of Date Pudding.

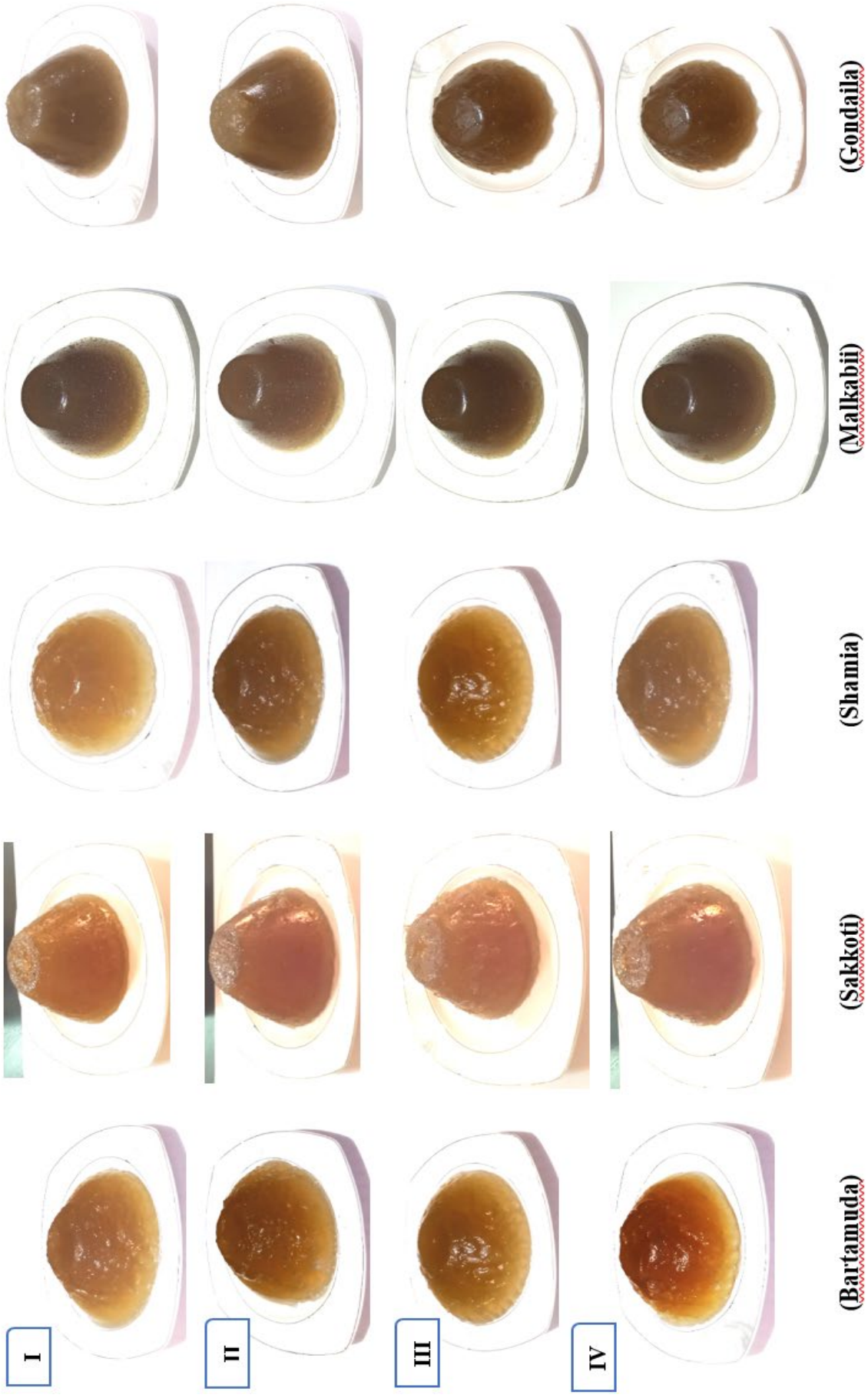

Fig. 5: Photography of Date Jelly.

Conclusion:

It can be concluded that the drying process of solar energy improved qualities of date products and obtain suitable ratios of pH, acidity and total soluble solids as well as improved the organoleptic characteristics of all date products that have been manufactured.

References:

Abd-Ellah, A.E.I. 2009. Chemical and technological studies on some Sudanese date cultivars. Ph.D. Thesis, College., of Graduate Studies., Nile Valley Univ., Sudan.

AOAC. 2005. Official Methods of Analysis of AOAC International, 18th ed., Assoc. Office Anal. Chem., Arlington, VA.

Borchani, C., S. Besbes, C. Blecker, M. Masmoudi, R. Baati and H. Attia. 2010. Chemical properties of 11 date cultivars and their corresponding fiber extracts. African Journal of Biotechnology, 9(26): 4096-4105.

Doymaz, I. 2005. Drying characteristics and kinetics of okra. Journal of Food Engineering, 69(3), 275-279.

Elghazali, M.N. and F. Hussin. 1999. Effect of sun drying and mechanical drying on chemical composition and lipid, phospholipid fraction of Aswan dry date. Zagazig J. Agric. Res, 26(5): 1303-1323.

El-Sharnouby, G.A., M.S. Al-wesali and A. Al-Shathri. 2007. Effect of some drying methods on quality of palm date fruits powder. The Fourth Symposium on Date Palm in Saudi Arabia, King Faisal University, Alahsa, 5-8 May 2007.

Kulp, K., P.M. Ranum, P.C. Williams and W.T. Yamazaki. 1980. "Natural levels nutrients in commercially milled wheat flours: I. Description of samples and proximate analysis", Cereal Chem., Vol. 57, pp. 54-8.

Kuras, M.J., M. Zielin´ska-Pisklak, J. Duszyn´ska and J. Jabłon´ska. 2020. Determination of the elemental composition and antioxidant properties of dates *(Phoenix dactyliferia)* originated from different regions. J. Food Sci. Technol., 57(8): ppt. 2828–2839.

Mendoza, F., P. Dejmek and J.M. Aguilera. 2006. Calibrated color measurements of agricultural foods using image analysis Postharvest Biol. Technol., 41, pp. 285-295.

Mundada, M., B.S. Hathan and S. Maske. 2010. Convective dehydration kinetics of osmotically pretreated pomegranate arils. Biosystems Engineering, 107(4), 307-316. http://dx.doi.org/10.1016/j.biosystemseng.2010.09.002.

Nadir, A., I.M.F. Helmy and K.I. Hamad. 2005. Production of improved products from date. Journal of Agriculture Sciences Mansoura Univ., 30(9): 5443-5458.

Okos, M.R., G., Narsimhan, R.K. Singh and A.C. Weitnauer. 1992. Food dehydration. In D. R. Heldman & D. B. Lund (Eds.), Handbook of food engineering (pp. 601-744). New York: Marcel Dekker.

Penfield, M.P. and A.M. Campbell. 1990. Experimental food science. Food science and technology (USA).

Seerangurayar, T., A. Manickavasagan, A.M. Al-Ismaili, Y.A. Al-Mulla. 2017. Effect of carrier agents on physicochemical properties of foam-mat freeze-dried date powder. Dry. Technol., pp. 1-12.

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and procedure of statistics a biometrical approach. Mc-Graw Hill.

Youssef, M.K.E. and B.R. Ramadan. 1987. Nutritive value of dates. Technical Bull. No. 15, September, Fac. Of Agric., Assiut Univ.

دراسات تكنولوجية على منتجات بلح اسوان الجاف بعد التجفيف

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الملخص

اجريت هذه الدراسة على خمسة أصناف من البلح الجاف الذي يزرع في محافظة اسوان - جمهورية مصر العربية - وهي أصناف السكوتى والبرتمودا والجنديله والشامية والملكابي وهي من أفضل اصناف نخيل البلح - وقد تم تقدير كل من المواد الصلبة الكلية الذائبة ودرجة تركيز أيون الايدروجين (pH) والحموضة الكلية وخصائص اللون والخواص الحسية، في منتجات التمر (تمر الدين بالألياف وبدون ألياف و جيلي التمر وبودنج التمر) التي تم تصنيعها من هذه الأصناف مجتمعة بعد الجني مباشرة في مرحلة التمر ثم بعد التجفيف الشمسى لمدة 25 يوم، والتجفيف بالطاقة الشمسية لمدة 14 يوم علي درجة حرارة متوسطة 50 درجة مئوية والتجفيف الميكانيكي على درجة 60 °م لمدة 9 ساعة وأجريت مقارنة بين هذه المعاملات. انخفض الرقم الهيدروجيني (pH) في جميع الأصناف التي تم تصنيعها من التمر بعد التجفيف بالشمس والتجفيف الميكانيكي والتجفيف بالطاقة الشمسية، بينما زادت المواد الصلبة الذائبة الكلية (TSS) والحموضة لجميع منتجات التمر أيضًا، وجدنا أنه بشكل عام قيم السطوع (L) و الاحمرار (a) والصفرة (b) كانت للمنتجات التي تم تصنيعها من التمور الطازجة أعلى من تلك التي تم تصنيعها من التمور المجففة بالطاقة الشمسية، تليها المنتجات المصنعه من التمور المجففة بالشمس و المنتجات المصنعه من التمور المجففة ميكانيكياً. لذلك لخصت هذه الدراسة إلى أن عملية التجفيف بالطاقة الشمسية قد حسنت صفات الجودة لجميع منتجات التمور التي تمت تصنيعها من تمور أسوان الجافة.