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# Production of New Untraditional Jam from Fruit Byproducts and Fortified with Mushrooms and Yellow Carrot

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***Abstract:***
*The fruit peels are considered as a big problem in the food industry, which cause pollution in the production lines during manufacturing stages, and the fruit peels are rich in nutrients and contain many phytochemicals. This study was conducted in order to prepare jam from orange peels, and has been prepared in ten different blends of jam, using orange peels and mushrooms (oyster) and yellow carrots. The choice fell on the six recipes are only the most palatable to the panelists, which recorded the highest scores of overall palatability performance. The chemical composition was determined, besides some analysis as well as physical and sensory evaluation.*
*The results revealed that the highest sensory quality standards were recorded by jam samples T5 (50% Orange peels +25% fresh mushroom+25% fresh yellow carrot and T3 (50% Orange peels +50% fresh Yellow carrot), followed by T4 (75% Orange peels +25% fresh mushroom) as well as in terms of overall palatability compared with other samples T2 (75% Orange peels +25% Orange pulp) and T6 (50% Orange peels +25% Orange pulp + 25% fresh mushroom as well as the control sample T1 (100% orange peels). Chemical composition was carried out for raw materials and jam samples, and the results showed that orange peels, mushrooms and yellow carrots they were good components to jam rich in protein, fiber and carotenoids.*
*As well as orange peels, yellow carrot considered as an excellent source of pectin. The results show that there is a clear increase of some contents in jam samples such as protein due to the use of mushrooms possessing high protein content, carbohydrates and fiber, which comes from yellow carrots and orange peel. Also, it could be observed that there were significant differences between each jam samples in the physical and chemical properties, except in the case of pH value, these differences can be due to the chemical composition of raw materials used to make jam. The results revealed that the increasing in the strength of jam and other measurements of different textures can be due to the presence of orange peels, yellow carrot which are rich in pectin content. It was also, observed that viscosity values in different jam samples increased. Those aforementioned samples have a high proportion of orange peels, yellow carrot, and this may be due to the increased concentration of pectin, which caused an increase in viscosity values.*
*Finally, it could be concluded through this study that, it is possible, practable and economic to utilize orange peels fortified with fresh oyster mushroom and yellow carrot in producing new untraditional value be characterized for its high nutritional value as well as its palatable properties and to improve the nutritional status, also, to protect the production lines from pollution, and to create new marketing way for oyster mushroom.*

***Keywords:*** *Jam, mushroom, orange peels, sensory evaluation and physicochemical analysis, yellow carrot.*

## 1. Introduction

Fruits and vegetables wastes and their by-products are remaining in great amounts during industrial processing and hence represent a serious problem, as they exert harmful impact on the environment. So, they need to be managed or they can be utilized (Duda-Chodak and Tarko, 2007). Citrus is genus of flowering plants in the family Rutaceae, native to tropical and subtropical areas in Southeast Asia. (Sawalha, *et al*., 2009) recorded that Citrus fruits have peculiar fragrance partly due to flavonoids and limonoids present in the peel and these fruits are good sources of vitamin C and flavonoids. It is also found to have antifungal activity (Velázquez-Nuñez, *et al*., 2013).

Orange peel is discarded in the orange-juice and soft-drink industries all over the world. Accumulation of orange waste in the orange industries has resulted in two important problems which are land space occupation and pollution with phenolic compounds due to dumping of this waste. Orange peel is mostly composed of cellulose, pectin, hemi-cellulose, lignin, chlorophyll pigments and other low molecular weight hydrocarbons which contain many hydroxyl functional groups thus making it a potential solvent for many pollutants. Since the orange peel is available free of cost from orange processing industries, many researchers have investigated its

potential as sorbent for various aquatic pollutants removal. The ability of fruit peel of orange to remove Zn, Ni, Cu, Pb and Cr from aqueous solution by adsorption was studied Ajmal, and Rao (2000).

An orange, specifically, the sweet orange (*Citrus sinensis* (*L.*) is the most commonly grown tree fruit in the world.Orange constitutes about 60% of the total citrus world production. In 2008, 3.23 million tons of citrus fruit were produced in Egypt, containing 2.14 million tons of orange. A large portion of this production is addressed to the industrial extraction of citrus juice, which leads to huge amounts of residues, including peel and segment membranes. Peels represent between 50 to 65% of the total weight of the fruits and remain as the primary byproduct Hegazy and Ibrahim, (2012). If not processed further, it becomes west produce odor, soil pollution, harborage for insects and can give rise to serious environmental pollution (Mandalari, *et al*., 2006). In Egypt and in many Mediterranean countries, major quantities of the peel are not further processed. Some attempts were made to use these residues as livestock feed, although their low nutritional value Bampidis and Robinson, (2006).

The fruit peels are rich in nutrients and contain many phytochemicals; they can be efficiently used as drugs or as food supplements too. Since there is an increase in the number of antibiotic resistant pathogens, there is always a search of an alternative drug that is regarded as safe. Fruit peels if proved to have antibacterial activity; they can be also used in the same food industry, which generates large peel wastes as a food preservative (Kumar, *et al*., 2011).

Mushrooms have a great nutritional value since they are quite rich in protein, with an important content of essential amino acids and fiber, and poor in fat. Edible mushrooms also provide a nutritionally significant content of vitamins (B1, B2, B12, C, D, and E) (Heleno, *et al*., 2010).

Yellow carrot is one of the important root vegetables rich in bioactive compounds like carotenoids and dietary fibers with appreciable levels of several other functional components having significant health-promoting properties. (Krishan, *et al*.,2012).

Thus, the present study aims to investigate the possibility of producing jam with high nutritional value and low production costs from orange peels fortified with both oyster mushroom and yellow carrot.

## 2. Materials and Methods

### *2.1. Materials*

Ripened and freshly harvested oranges (Baladi) fruits, yellow carrot (season October 2015) were purchased from local markets, and fresh Oyster Mushroom (*Pleurotus ostreatus*) was obtained from Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

### *2.2. Methods*

2.2.1. Jam Preparation

A modified method as described by **Adepoju*et al.* (2010)** was used to prepare the jam. Kenwood kitchen blender was used to blend and homogenize the raw material. Orange fruit was washed with tap water, then, peeled and their edible portions were carefully separated. Peels soaked for 30 min. in clean water after that, soaked water was removed then, the soaked peels were grounded using a grinder.

| Ingredients(g) Treatments | Orange Peel | Orange Pulp | Fresh Mushroom | Fresh Yellow Carrot | Sucrose | Citric Acid |
|---|---|---|---|---|---|---|
| T1 | 100 | - | - | - | 100 | 0.3 |
| T2 | 75 | 25 | - | - | 100 | 0.3 |
| T3 | 50 | - | - | 50 | 100 | 0.3 |
| T4 | 75 | - | 25 | - | 100 | 0.3 |
| T5 | 50 | - | 25 | 25 | 100 | 0.3 |
| T6 | 50 | 25 | 25 | - | 100 | 0.3 |

*Table 1: Ingredients percentages of different prepared orange peel jam recipes.*

**T1:**100% orange peels (as control). **T2**: 75% Orange peels +25% Orange pulp.
**T3:** 50% Orange peels +50% fresh yellow carrot. **T4:** 75% Orange peels +25% fresh mushroom.
**T5:** 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot.
**T6:** 50% Orange peels +25% Orange pulp + 25% fresh mushroom.

Fresh yellow carrot was cleaned and washed with tap water, then, cutting to small slices and soaked with little amount of clean water for 15 minutes. The soaked yellow carrot and soaked water were grounded. Fresh oyster mushrooms were cleaned and grounded either. To 500g of the Grounded peels, mushroom and yellow carrot were added 500g of sugar and 250ml of water. 0.3g citric acid was also added to enhance gel formation, improve color and flavor of the jam. The mixture was left at room temperature for 45 minutes and then cooked slowly with occasional stirring for twenty (20) minutes. The jam is ready when the temperature of the mixture reached to 105°C and the bubbles form at the sides of the vessels. The cooked jam was poured into a sterilized bottle and allowed to cool at room temperature (25±2 °C).

2.2.2. Sensory Evaluation

Sensory evaluation of peel jam was conducted by more than ten panelists (chosen by random) in the Food Technology Research Institute, according to the method of (Lindley *et al.,* 1993). Sensory attributes (color, taste, odor, texture and overall palatability) for peel jam. The sensory attributes (color, taste, odor, texture and overall palatability) were evaluated directly after preparation.

*2.3. Chemical Analysis*

Samples were chemically analyzed for moisture, ash, crude protein, crude fiber, total soluble solids (T.S.S.) and ether extract contents according to the methods described in the (AOAC, 2012).

Carbohydrate content was calculated by difference (FAO, 2003).

Total carotenoids and color index were determined as described by Ranganna (1979).

Pectin content was determined by the method of Lees (1975).

*2.4. Texture Profile Analysis*

Jam samples texture was determined by a universal testing machine (Cometech, B type, Taiwan). Flat head stainless cylindrical probe of 2 mm diameter was used for penetration test. The start of penetration test was the contact of the probe and sample surface, finish – when the probe penetrated the tissues to 50% of sample height. The probe speed was 1 mm s-1. **Bourne (2002).**

2.4.1. Determination of Viscosity Values

Viscosity of peel jam prepared solutions was measured by using Brookfield Engineering labs DV-III Ultra Rheometer. The sample was placed in a small sample adapter and a constant temperature water bath was used to maintain the desired temperature. The Viscometer was operated at 10 rpm. Viscosity data were obtained directly from the instrument, the HA-07 spindle was selected for the measurement at room temperature (25°C±1).

*2.5. Statistical Analysis*

The results were analyzed by analysis of variance (ANOVA) using the procedure by statistical analysis system (SAS) program, according to (Steel and Torri, 1980). Significant differences were determined at the level P≥0.05.

**3. Results and Discussion**

Organoleptic characteristics. The mean acceptance scores for the orange jam formulations are presented in Table (2). There was a significant difference ($p \leq 0.05$) among the formulations for color, taste, odor, texture and which indicated that these attributes were responsible for the differentiation among the jam samples. The data revealed that sensory quality parameters of jam sample (T5 and T3) followed by (T4) showed excellent organoleptic characteristics and overall palatability as compared to other samples (T2 and T6) as well as to control sample (T1).

It was clear that using fresh yellow carrot for a given species improved color of jam produced from orange peels and fresh mushroom, and resulted in final products of significantly different quality. These differences could be due to the nature of the raw material, its chemical composition and using of orange peels and fresh mushroom in addition of fresh yellow carrot.

| Sensory parameters Jam formulations | Color | Taste | Odor | Texture | Over all palatability |
|---|---|---|---|---|---|
| **T1** | **5.60$^{d}$**±0.69 | **4.90$^{e}$**±0.34 | **6.00$^{e}$**±0.24 | **5.00$^{d}$**±0.67 | 6.00$^{e}$±0.30 |
| **T2** | **7.00$^{c}$**±0.25 | **6.60$^{d}$**±0.33 | **6.60$^{de}$**±0.36 | **6.10$^{c}$**±0.33 | 7.00$^{d}$±0.61 |
| **T3** | **10.0$^{a}$**±0.34 | **9.00$^{b}$**±0.52 | **8.30$^{b}$**±0.35 | **8.00$^{b}$**±0.65 | 9.00$^{b}$±34 |
| **T4** | **6.00$^{d}$**±0.12 | **7.50$^{c}$**±0.54 | **7.50$^{c}$**±0.66 | **7.50$^{b}$**±0.24 | 8.00$^{c}$±0.58 |
| **T5** | **9.00$^{b}$**±0.27 | **10.0$^{a}$**±0.61 | **9.80$^{a}$**±0.45 | **10.0$^{a}$**±0.65 | 10.0$^{a}$±0.68 |
| **T6** | **6.80$^{c}$**±0.59 | **7.00$^{d}$**±0.22 | **7.10$^{cd}$**±0.52 | **7.50$^{b}$**±0.44 | 7.90$^{c}$±0.55 |

*Table 2: Mean sensory scores of jam made from orange peels and mushroom*

All values are means of three replicates ± stander deviation (SD). Values in the same column with different letters (a, b, c and d) are significantly different ($P \leq 0.05$).

T1:100% orange peels (as control). T2: 75% Orange peels +25% Orange pulp.

T3: 50% Orange peels +50% fresh yellow carrot. T4: 75% Orange peels +25% fresh mushroom. T5: 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot.

T6: 50% Orange peels +25% Orange pulp + 25% fresh mushroom.

The results confirmed the complexity of the interactions between sensory perception and the factors investigated. The majority of the sensory attributes investigated turned out to be significantly influenced using of orange peels and fresh mushroom in addition of fresh yellow carrot, also improved sensory attributes. These results in good agreement with the results recorded by (Ihediohanma, *et al.,* 2014) who noticed that sensory attributes improved by mixing more than one of raw material and orange peel is a good source of pectin, which can be successfully applied in food gel systems such as fruit jams.

*3.1. Chemical Composition of Raw Materials*

The results of the proximate analysis of fresh orange peels, orange pulp, oyster mushroom and yellow carrot are presented in Table (3) show that oyster mushroom had the highest content of protein (26.05%) followed by yellow carrot and orange peels (9.31, 4.15%), respectively, as for, carbohydrate content the data indicated that orange pulp, orange peels, yellow carrot and oyster mushroom had (85.82, 72.11, 68.95and 55.98%), respectively. Meanwhile, yellow carrot and orange peels recorded high content of crude fiber and ether extract reached to (15.98, 11.10 and 2.42, 9.87%), respectively. The results show that the highest content of ash was recorded by yellow carrot and mushroom (8.50 and 6.3%) respectively. These results were in agreement with those recorded by (Sara and Sherry, 2010, Filipa, *et al*., 2012 and Oikeh, *et al*., 2013). Whom revealed that the main three raw material contains chemical composition in the range of our data. These results indicated that orange peels, oyster mushroom and yellow carrot were a good source as jam ingredients. However, orange peels and yellow carrot were considered as an excellent source of pectin. As, recorded in Table (3) the data show that orange peels had a high content of pectin and total carotenoids followed by yellow carrot, these results were comparable with those recorded by (Nessma, 2015) who is recorded that total carotenoids of orange peels 0.22 mg/g, and (Abdel Moneim, *et al*., 2013), who revealed that the amount of orange peel pectin reached to 20.75%.

| Samples Constituents | Orange peels | Orange pulp | Mushroom | Yellow carrot |
|---|---|---|---|---|
| **Moisture content %** | **10.42**±1.43 | **11.87**±1.81 | **10.10**±1.16 | **10.82**±1.10 |
| **Ash content %** | **3.45**±0.57 | **0.81**±0.06 | **6.30**±0.09 | **8.50** ±0.05 |
| **Crude protein content %** | **4.15**±0.11 | **0.91**±0.04 | **26.05**±0.15 | **9.31**±0.58 |
| **Ether extracts content %** | **9.87**±0.89 | **0.59**±0.03 | **1.57**±0.05 | **2.42±**0.08 |
| **Crude fiber content %** | **11.10**±0.56 | **4.60**±0.15 | **2.26**±0.10 | **15.98**±0.09 |
| **Total carbohydrate%** | **72.11**±0.52 | **85.82**±1.02 | **55.98**±0.75 | **68.95**±1.56 |
| **Pectin content(g/100g)** | **18.75**±1.25 | **0.75**±0.08 | **ND** | **6.89**±1.10 |
| **Total carotenoids mg/100g** | **2.1**±0.08 | **0.89**±0.2 | **0.15**±0.01 | **7.6**±0.29 |

*Table 3: Chemical properties of raw materials used in production of orange peel jam (On dry weight basis). Values expressed are means ±S. D of three parallel measurements.*

*3.2. Chemical Composition of Different Prepared Orange Peel Jam Recipes*

Proximate analysis of different prepared orange peel jam samples is presented in Table. (4) the given data indicated that there were significant differences among all of the ingredients, and moisture content ranges between 26.72% in T1 and 32.84% in T6, jam samples contain a higher moisture percentage depending on the kind of ingredient used. Jam sample T5 which consisted of (50% Orange peels +25% fresh mushroom +25% fresh Yellow carrot) had the highest content of crude protein and ash. Carbohydrates, calculated discounting protein, ash, moisture and fat contents, were the most abundant macronutrients and the highest levels were also, found in jam sampleT1 followed by T3 and T2. Although, an extraordinarily high or appreciable content of total fiber was reported forT3 and T5, this may be due to yellow carrot and mushroom.

| Constituents Formulations | Crude fiber content % | Moisture content % | Ash content % | Crude protein content % | Ether extracts content % | Total carbohydrate % |
|---|---|---|---|---|---|---|
| **T1** | **2.75**$^{b}$±0.09 | **26.72**$^{c}$±1.41 | **0.58**$^{c}$±0.03 | **1.08**$^{f}$±0.03 | **4.10**$^{a}$±0.10 | **66.91**$^{a}$±1.46 |
| **T2** | **2.46**$^{cd}$±0.10 | **29.70**$^{bc}$±0.83 | **0.66**$^{b}$±0.02 | **1.35**$^{e}$±0.05 | **2.39**$^{d}$±0.09 | **65.93**$^{a}$±0.77 |
| **T3** | **3.30**$^{a}$±0.15 | **28.17**$^{c}$±1.02 | **0.68**$^{b}$±0.05 | **2.29**$^{d}$±0.02 | **2.68**$^{d}$±0.20 | **66.16**$^{a}$±1.86 |
| **T4** | **2.63**$^{bc}$±0.12 | **31.14**$^{a}$±1.20 | **0.55**$^{c}$±0.03 | **4.37**$^{b}$±0.03 | **3.12**$^{bc}$±0.10 | **60.82**$^{b}$±1.14 |
| **T5** | **3.20**$^{a}$±0.16 | **29.91**$^{bc}$±1.04 | **0.81**$^{a}$±0.06 | **6.08**$^{a}$±0.06 | **3.49**$^{b}$±0.08 | **59.75**$^{b}$±1.99 |
| **T6** | **2.39**$^{d}$±0.12 | **32.84**$^{a}$±1.29 | **0.77**$^{a}$±0.03 | **3.52**$^{c}$±0.07 | **2.74**$^{cd}$±0.03 | **60.16**$^{b}$±1.09 |

*Table 4: Proximate analysis of different prepared orange peel jam recipes (On dry weight basis)*

All values are means of three replicates ± stander deviation (SD). Values in the same column with different letters (a, b, c and d) are significantly different ($P \leq 0.05$). **T1**:100% orange peels (as control).

**T2**: 75% Orange peels +25% Orange pulp.

**T3:** 50% Orange peels +50% fresh yellow carrot. **T4:** 75% Orange peels +25% fresh mushroom.

**T5:** 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot.

**T6:** 50% Orange peels +25% Orange pulp + 25% fresh mushroom

Jam sample (T5) revealed the high ash content (0.81%) and the lowest ash content was recorded by Jam sample (T4), meanwhile, high fat content found in jam sample T1 (4.1%) but, jam sample (T2) gave the lowest fat content (2.39%). It could be observed from proximate composition of jam samples that increasing of some components like protein, carbohydrates and fiber due to using of mushroom with high protein content, yellow carrot and orange peel only. These results were in agreement with those recorded by (**Sara and Sherry, 2010, Filipa, *et al*., 2012 and Oikeh, *et al*., 2013)** whom recorded a comparable data to our previous results.

*3.3. Physicochemical Characterization of Jam Samples*

3.3.1. The Analysis of Jam Quality

The analysis of jam quality was determined and tabulated in Table (5) from these data it could be observed that were significant differences between all jam samples in the physicochemical characteristics except in case of pH value there were no significant differences were found, these differences could be due to chemical composition of raw material used, also, it could be noticed that jam sample (T2) recorded high total sugar and reducing sugar contents (63.25 and 25.28%), respectively. Meanwhile, the lowest total sugar and reducing sugar contents were recorded by (T1) and it were (57.32 and 19.11), respectively. On other hand, Total acidity (as citric acid) ranged from (0.32 to 0.48%), pH value ranged from (3.33 to 3.36), as for, total soluble solids and total carotenoids content the results indicated that there were significant differences between all jam samples and T1, T3 had the highest content of total soluble solids these data may be due to content of pectin, meanwhile, the high content of carotenoids were recorded by T3,T5 these results may be attribute to presence of yellow carrot and orange peels ( **Nessma, 2015 )**.

| Constituents<br>Formulations | Total sugars% (DWB) | Reducing sugars% (DWB) | Total acidity (as citric acid) % | pH value | Color index | T.S.S.% | Total carotenoids mg/100g |
|---|---|---|---|---|---|---|---|
| **T1** | **57.32$^{b}$**±1.52 | **19.11$^{e}$**±0.50 | **0.31$^{c}$**±0.01 | **3.36$^{a}$**±0.10 | **0.24$^{d}$**±0.01 | **68.11$^{a}$**±1.98 | **1.09$^{c}$**±0.05 |
| **T2** | **63.25$^{a}$**±0.79 | **25.28$^{a}$**±1.02 | **0.33$^{c}$**±0.02 | **3.35$^{a}$**±0.10 | **0.14$^{e}$**±0.02 | **66.72$^{c}$**±1.85 | **0.54$^{e}$**±0.02 |
| **T3** | **58.06$^{b}$**±1.04 | **20.38$^{de}$**±0.72 | **0.37$^{b}$**±0.01 | **3.34$^{a}$**±0.02 | **0.65$^{a}$**±0.03 | **67.15$^{b}$**±1.98 | **2.89$^{a}$**±0.07 |
| **T4** | **58.99$^{b}$**±1.64 | **24.31$^{ab}$**±1.00 | **0.48$^{a}$**±0.04 | **3.33$^{a}$**±0.03 | **0.10$^{f}$**±0.02 | **65.77$^{e}$**±0.96 | **0.41$^{f}$**±0.03 |
| **T5** | **60.32$^{b}$**±1.97 | **21.66$^{cd}$**±1.33 | **0.32$^{c}$**±0.01 | **3.36$^{a}$**±0.04 | **0.43$^{b}$**±0.02 | **66.15$^{d}$**±0.97 | **1.84$^{b}$**±0.04 |
| **T6** | **59.56$^{b}$**±1.52 | **23.19$^{bc}$**±1.00 | **0.39$^{b}$**±0.02 | **3.35$^{a}$**±0.03 | **0.32$^{c}$**±0.02 | **66.84$^{c}$**±1.10 | **0.85$^{d}$**±0.03 |

*Table 5: Analysis of jam quality control*

All values are means of three replicates ± stander deviation (SD). Values in the same column with different letters (a, b, c and d) are significantly different ($P \leq 0.05$).

T1:100% orange peels (as control). T2: 75% Orange peels +25% Orange pulp.

T3: 50% Orange peels +50% fresh yellow carrot. T4: 75% Orange peels +25% fresh mushroom. T5: 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot.

T6: 50% Orange peels +25% Orange pulp + 25% fresh mushroom

These data are in agreement with the requirement of jam quality control and are falling within the range of recorded by (Abdelwahab, *et al*., 2011). However, color index was detected and the data show that jam sample (T3) recorded the value, followed by (T5), and this could be due to yellow carrot which enhancement production color.

*3.4. Texture Profile of Different Jam Samples*

The texture profile analysis (TPA) property of jam firmness, which is equivalent to the force of mastication during eating (Guine and Barroca, 2012), and it's a very useful technique for investigating food products. In the present study, the TPA parameters of jam samples were determined from the texture analyzer using double compression tests and are shown in Table (6).

| Formulations<br>Texture Parameters | T1 | T2 | T3 | T4 | T5 | T6 |
|---|---|---|---|---|---|---|
| **Firmness** | **0.442$^{a}$**±0.012 | **0.441$^{a}$**±0.011 | **0.351$^{b}$**±0.003 | **0.244$^{d}$**±0.023 | **0.287$^{c}$**±0.004 | **0.246$^{d}$**±0.006 |
| **Cohesiveness** | **0.679$^{d}$**±0.009 | **0.634$^{e}$**±0.004 | **1.090$^{a}$**±0.025 | **0.929$^{b}$**±0.008 | **0.882$^{c}$**±0.004 | **0.695$^{d}$**±0.004 |
| **Gumminess** | **0.293$^{b}$**±0.002 | **0.275$^{c}$**±0.004 | **0.333$^{a}$**±0.020 | **0.226$^{d}$**±0.001 | **0.295$^{b}$**±0.003 | **0.170$^{e}$**±0.01 |
| **Chewiness** | **0.255$^{b}$**±0.003 | **0.235$^{c}$**±0.004 | **0.316$^{a}$**±0.015 | **0.222$^{cd}$**±0.002 | **0.212$^{d}$**±0.003 | **0.140$^{e}$**±0.01 |
| **Springiness** | **0.865$^{c}$**±0.001 | **0.974$^{a}$**±0.003 | **0.941$^{b}$**±0.002 | **0.844$^{d}$**±0.005 | **0.837$^{e}$**±0.002 | **0.824$^{f}$**±0.003 |
| **Resilience** | **0.044$^{d}$**±0.004 | **0.080$^{b}$**±0.01 | **0.065$^{c}$**±0.004 | **0.042$^{d}$**±0.003 | **0.041$^{d}$**±0.008 | **0.151$^{a}$**±0.002 |

*Table 6: Texture profile of different jam samples (Newton).*

All values are means of three replicates ± stander deviation (SD). Values in the same raw with different letters (a, b, c and d) are significantly different ($P \leq 0.05$).

T1:100% orange peels (as control). T2: 75% Orange peels +25% Orange pulp.

T3: 50% Orange peels +50% fresh yellow carrot. T4: 75% Orange peels +25% fresh mushroom. T5: 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot.

T6: 50% Orange peels +25% Orange pulp + 25% fresh mushroom

The Firmness values of jam tended to decrease on addition of mushroom compared to control and the other samples. However, cohesiveness determined from the area of work during the second compression divided by the area of work during the first compression (Bourne, 2002) ranged between about (0.634 to 1.09) for T2 and T3 with significant difference between the samples.

Whereas, the highest values of springiness, gumminess were recorded by (T4, T3), respectively. As for, chewiness and resilience the data revealed that (T3, T6), while the lowest values were recorded by (T6, T5). The results revealed that the increasing in the strength of jam and other measurements of different textures can be due to the presence of orange peels, yellow carrot which are rich in pectin content.

*3.5. Determination of Viscosity*

Viscosity was determined for jam samples with a Viscometer at room temperature (35°C), and the results were shown in the following Fig. (1).

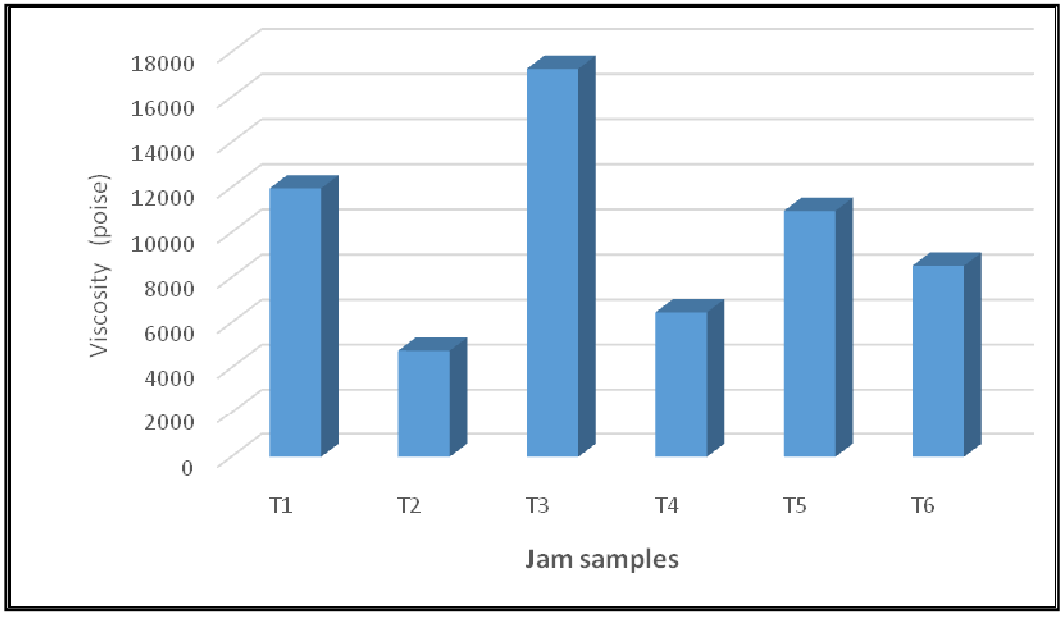


*Figure 1: Determination of viscosity value of jam samples*

**T1:**100% orange peels. **T2:** 75% Orange peels +25% Orange pulp.
**T3:** 50% Orange peels +50% fresh yellow carrot. **T4:** 75% Orange peels +25% fresh mushroom.
**T5:** 50% Orange peels +25% fresh mushroom+25% fresh yellow carrot. **T6:** 50% Orange peels +25% Orange pulp + 25% fresh mushroom.

Data as cleared from the following figure it was revealed that jam sample (T3) which consisted of (50% Orange peels +50% fresh Yellow carrot) had the highest viscosity value, followed by jam sample (T1) which consisted of (100% orange peels), then, jam sample (T5) which consisted of (50% Orange peels +25% fresh mushroom+25% fresh Yellow carrot).

Meanwhile, the lowest value was recorded by jam sample T2, which consisted of (75% Orange peels +25% Orange pulp). It was observed that viscosity values increased in jam different samples containing of orange peels and yellow carrot, this may be due to increase of pectin concentrations which caused viscosity to also increase. These results were in agreement with the results which recorded by (Seyed *et al*., 2016) who noticed the same results. Also, changes in viscosity are due to many factors such as increasing of sugar content and temperature degree, these data in good agreement with the results recorded by (Marjan and Johari.2010) who revealed that change in apparent viscosity is probably due to sugar presence.

## 4. Conclusion

The study recommends to take advantage of the orange peels in production of new untraditional jam and improved by adding fresh mushrooms and yellow carrots with good sensory properties and overall palatability, with a reasonable content of protein and pectin, as well as improving the nutritional status. Also, and to protect the production lines of pollution, and create a new way to market mushroom.

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