OPEN ACCESS Int. J. Agr. Ext. 10 (01) 2022. 219-231 DOI: 10.33687/ijae.010.01.4191

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Available Online at EScience Press

International Journal of Agricultural Extension

ISSN: 2311-6110 (Online), 2311-8547 (Print)

https://esciencepress.net/journals/IJAE

PHYSIOCHEMICAL COMPARISON OF BLACK AND GREEN GRAPES VARIETIES AND SENSORY EVALUATION OF JAM IN PUNJAB, PAKISTAN

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ARTICLE INFO

Article History

Received: July 21, 2021

Revised: December 15, 2021

Accepted: January 22, 2022

Keywords

Grapes

Jam

Sensory

Physicochemical

Households

ABSTRACT

To achieve food security, the contribution of fruits is viewed as equally important to major crops. Because, fruits are rich in nutrients too. In this study, two varieties of grapes i.e., green (Sundarkhani) and black (NARC Black) are compared through their proximate, antioxidant, and total phenolic content determination through respective methods. Afterward, the analyzed grape varieties were subjected to Jam development. The produced jams from both varieties were assessed for total soluble solids, pH and acidity. Considering the implications for the dietary intake, a sensory evaluation was conducted on a fortnightly basis for the period of two months. Findings regarding physiochemical comparison showed that both varieties were statistically different in terms of moisture, crude fat, crude fiber, total phenolic content, titratable acidity, PH and TSS. Findings regarding, sensory comparison of products proved that black grapes jam was more acceptable in general public as compared to green grapes jam. Black grapes jam depicted higher acceptance because of its higher overall acceptability, maximum textural and flavor properties. Sensory characteristics appearance, texture, color, flavor, aroma, and overall acceptability of jam appeared decreasing with storage. This implies that the byproducts of the grapes can be helping farmers to achieve food security and also earn capital by domesticating the by-products on households' level. However, this objective cannot be achieved without the synergic working of institutes like horticulture, post-harvest and agricultural extension, who are the front-line workers for the farmers assistance.

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INTRODUCTION

Food security is a mounting challenge that is being addressed through the multi-sectoral linkages and embedding all food resources to reach nutritive level of food intake. Apart from the field crops, fruits have the tremendous potential, although yet to be exploited. Grape is one of the key fruits to contribute to food security measures. Although, it is a minor fruit and appears for shorter period of time in season, development of value-added product to combat nutritional deficiencies and to minimize post-harvest losses will be a great step.

Grape (also called "Angoor" in Persian and Urdu) is botanically a berry and belongs to the genus Vitis of Family Vinifera, which is one of the most popular fruits in the world and have a long abundant history. Grapes

and their products are considered among the chief and the oldest cultivated plants all over the world. Grape originated from Asia and now they have been spread to the whole world. As per statistical report on world vitiviniculture, 5 countries i.e., Spain, China, France, Italy, and Turkey are the largest producers of grapes which constitute a total of 51% of world grapes production. Grapes are grown in large quantities and consumed as whole or in various processed forms all over the world, while in Pakistan grapes are consumed mainly as whole or in processed forms such as raisins, vinegar etc. Turkey and the US are the largest producers and exporters of grapes and raisins while more than 70% of the grape varieties are grown in North America. The global area under the production of grapes was 7.4 MHA in 2018. In Pakistan, 14.8 thousand hectares of area were under the production of grapes and in the same year, 66.2 thousand tonnes of grapes were produced while the yield per hectare was 4473 Kg (PBS, 2017).

The classification of grapes according to their intended use is raisins grapes, wine grapes, table grapes, and so on; seedless or with edible seeds. Grape berries as a whole contain many 3 nutritional components such as carbohydrates, minerals, vitamins, edible fibres and phytochemicals. The energy obtained from 100g of grapes is 288kJ or 69 kcal. The total carbohydrates in a 100g grapes sample are found to be 18.1g where sugars and dietary fiber account for 15.48g and 0.9g respectively. The fat, protein, and vitamins in the sample are found to be 0.16g, 0.72g, and 0.93g respectively (Xia *et al.*, 2010). Grapes are generally used as fresh (table grapes), or in processed forms such as jams, jellies, juice etc. They are considered rich fruit to be used in such products and demonstrate a wide range of health benefits due to a large number of antioxidants, vitamins, phenolics, flavonoids and a group of nutraceuticals present in the fruit (Pop *et al.*, 2015).

Because of the high nutritional content and antioxidant activity of grapes, they are consumed in large quantities globally. Major processed forms include jams, jellies, juice, wine, marmalades, toppings etc. In 2009, approximately 66.9 million tons of grapes were produced from 7.43 million hectares of area under grapes cultivation. Almost 71% of the global grape production accounts for producing wine, 27% are used as fresh fruit, and 2% is used as a dried fruit. A fraction of grape production is used to produce grape juice, for canned fruits, to be reformed "with no added sugar" as well as "100% natural.

Grapes evolved from Asia Minor, in a region towards the south and between the Caspian and Black Seas. From there, grapes propagated to six (6) continents and now, they are being grown everywhere in the world in a significantly suitable environment. However, North America is the inherent habitat for over 70% of the total grapes species in the world (USDA, 2009).

At the commercial level, grapes are categorized as either table grapes or wine grapes. The basis of this categorization is the intended use and method of consumption i.e., table grapes to be eaten in raw form, and wine grapes to be utilized for winemaking. The other commercial grape varieties can also be classified as canning grapes, dried or raisin grapes, sweet juice grapes, and table grapes. Preserving grapes through raisins formation is a highly profit-making business in numerous grape-producing countries. The global raisin production was approximately 1.3 million tons in the year 2018 (OIV, 2019). Turkey and the United States are the major countries that produce and export raisins. Historically, the raisin production from Turkey and the US together contributes approximately 80% to the total raisin production in the world (USDA, 2009).

MATERIALS AND METHODS

The current study was conducted in the Department of Food Science and Technology (FST) at MNS-University of Agriculture, Multan (MNS-UAM). The planned research work was performed in Microbiology Lab and Post-Harvest Lab. In the current study, two varieties of grapes were analyzed for the proximate composition and used for the product development. Furthermore, the prepared products were subjected to further analysis. The procedures and protocols used are discussed below.

Procurement of raw material

Two varieties of grapes NARC black and Sundarkhani were obtained from the local market by considering quality traits such as size, shape, colour, damage & abrasion-free and maturity level. The fruit was washed, cleaned and dried before storage. Conditions of refrigeration were ensured to maintain the quality of particular fruit.

Characterization of fruit

Numerous analyses of raw fruit as proximate and phenolic content were carried out. During the product

development phase, grapes jam for each variety was prepared followed by their sensory evaluation and respective analysis.

Chemicals

All the chemicals were available in the research laboratory of the Department of Food Science and Technology and the Post-harvest laboratory of the Department of Horticulture, MNS-University of Agriculture, Multan, Pakistan.

Proximate composition

The fresh grape varieties were used to determine the nutrient distribution including the moisture content, ash, crude fat, crude fiber and crude protein according to the method described by the Association of Official Analytical Chemists (AOAC, 2000). The details of these mentioned parameters are given below:

Moisture (%)

The moisture content of grapes berries was measured through the differential method by using a Hot air oven at temperatures of about 105±5°C until a constant weight was achieved i.e. AOAC (2000) method. The initial weight of the grape berries sample was recorded and kept in a hot air oven for 24 hours at 105°C. After 24 hours, the sample was taken out from the hot air oven and kept in a desiccator immediately to avoid reabsorption of moisture. As the sample cooled down in the desiccator, it was weighed. The difference in initial and final weight revealed the moisture content of the sample.

Calculations

The moisture content was calculated by following the formula:

Moisture % = Difference in weight / Final weight * 100

Where,

The difference in weight = W1-W2

W1= Initial weight of berries

W2= Final weight after drying

Crude fat (%)

The grapes sample was subjected to the determination of crude fat (%) by using the Soxhlet System mentioned in Method of AOAC (2000). Purposely, the pre-weighed sample was taken in a filter paper thimble and weighed again. The extraction unit was filled with 350 ml petroleum ether and assemble the flask on the apparatus. The apparatus was set for running. The thimble was placed in the thimble jacket then the heating system was switched on. After complete washing, the heat was switched off and the system was left for cooling. The thimble was removed from the apparatus and placed outside in the air to dry. The dried thimble was placed in Hot Air Oven at 70 °C for 20-30 minutes to remove further moisture. After moisture removal, the dried thimble was taken out from the Hot Air Oven and placed in a desiccator for cooling.

Calculations

The crude fat contents were calculated by the following formula:

Crude fat % = Difference in weight / Final weight * 100

Where,

Difference in weight = W1-W2

W1 = weight of sample + thimble

W2 = weight of defatted sample + thimble

Ash content (%)

In ashing organic particles of the sample was burnt and the remaining content of the sample was inorganic known as ash content. Each variety of grapes was subjected for the ash analysis. Purposely, 2g of grape sample was taken in crucible for charring. Charring was done by placing the crucibles on a spirit lamp and appropriate heat was given till sample showed black color and become smokeless. After charring, these crucibles were placed in desiccator for some time for desorption of moisture. Then all crucibles were removed from desiccator and weighted. After weighing, the crucibles were placed in the muffle furnace. The Muffle furnace was run at 650 ○C for 5 hours. By following the method of AOAC (2000) duplicate sample was run for the calculation of ash % in grapes.

Calculations

Ash content = Sample weight after ashing / Sample weight before ashing ×100

Crude fiber content (%)

To determine the crude fiber, 2g sample of dry grapes sample was used for digestion with 1.25% H_2SO_4 for 30 min. H_2SO_4 solution was made by pouring 0.255 N H_2SO_4 in 200 ml of distilled water in a beaker. Then the beaker was placed on hot plate and the magnetic stirrer was put in that beaker. After digestion with H_2SO_4, the sample was subjected for filtration. Then filtrate was poured in another digestion flask that was prepared from NaOH

(0.1 N) and distilled water (200 ml).

Second digestion was carried out for further 30 min. Afterwards, the sample was subjected for filtration according to the set procedure mentioned above. The filtrate was weighed accurately and placed in hot air oven at 110◦ C till constant weight. Later, the sample was placed in desiccator for cooling. Then dried sample was placed in a crucible and subjected for ignition in a muffle furnace at 650°C for 5 hours. Then sample was removed from muffle furnace and weighed again that was denoted as W2. The method of AOAC (2000) was followed by running the 2 duplicates sample of the raw fruit.

Calculations

Fiber content = Weight of digested sample after ashing / Weight of raw sample ×100

Note: The first step i.e. washing of moisture-free samples to remove fat was omitted due to negligible amount of fat as prescribed by Madhu *et al.* (2017).

Crude protein (%)

The crude protein contents were evaluated through the Kjeldahl apparatus according to the method suggested by AOAC (2000). The Kjeldahl apparatus was composed of three steps including digestion, distillation and titration.

Calculations

The crude protein content was checked following the assistance as:

Percent Nitrogen × 6.25 = percent protein

Where N% = (Vol. of 0.1N H2SO4×Vol. of dilution 0.0014×B / Weight of sample×10) * 100

Nitrogen free extract (NFE %)

The nitrogen free extract of moisture free sample was evaluated by subtracting the sum of proximate values from 100 using the following equation (Aina *et al.*, 2012).

NFE% = 100 – (Moisture content + Fat content + Fiber content + Protein content + Ash content) %.

Physicochemical analysis

Following physicochemical analyses were carried out for each variety of grapes.

Total soluble solids (°Brix)

The total sugars in the grapes were determined by using a refractometer. The grape berries were homogenized by crushing. A single drop of homogenized grape was put on the refractometer and the reading it will give, will be recorded as total sugars AOAC (2000).

Titratable acidity

The titratable acidity of fruit will be determined by taking 10ml of juice diluted with 10mL of water followed by titration with 0.1N NaOH (Lurie, 2007). Following formula was used for TA determination:

$$\text{Titrateable acidity \%} = \frac{0064X\text{Volume of NaOH used}}{10X100}$$

pH

The determination of the pH of grapes juice was carried out through a pH meter (Dami, 2014).

Analysis of total phenolic content (TPC)

Grapes sample was analyzed for the assessment of TPC by Folin-Ciocalteau's reagent as prescribed by the method of Razzaq *et al.* (2013).

The amount of phenolic content present in the sample was calculated as:

Phenol (mg/g) = Sample O.D × Dilution factor × Graph factor

1, 2-Diphenyl-2-picrylhydrazyl (DPPH) assay

The calculation of free radical scavenging activity was analyzed spectrophotometrically by the method proposed by Xu and Chang (2007).

The radical scavenging activity of the sample will be calculated by the equation below:

% Inhibition =¼ A0- A1/ A0* 100

Where,

A1 and A0 are the absorbance of blank reagent and sample, respectively.

Product development

Grapes jam was developed for both varieties of grapes separately by adding sugar to the grape puree and cooking it until desired consistency was achieved. Once the desired consistency was achieved, the jam was left to cool at room temperature. As the product reached room temperature, the preservative was added to it and it was sealed for 14 days to avoid consumption. However, the proximate, as well as physicochemical analyses, were carried out for the jams on zero, 15th, 30th, 45th and 60th day to check for differences in pH, TSS and acidity with

respective methods whilst, for sensory evaluation 9-point hedonic scale was used (Lawless and Heymann, 2010).

Sensory evaluation of product

The prepared jams were evaluated from 10 judges at the Department of Food Science and Technology MNS-University of Agriculture, Multan. The jams were assessed by the panelist according to the hedonic scale (Lawless and Heymann, 2010) where, 9 represented extremely like and 1 for extremely dislike. Sensory evaluation of jams was conducted to evaluate the quality characteristics including texture, color, taste, aroma and overall acceptability by following the methodology described by Wichchukit and O'Mahony (2015).

Chemical and physical analysis

The physicochemical analyses of the jams of both grape varieties were carried out on zero, 15th, 30th, 45th and 60th day to check for differences in pH, TSS and acidity with respective methods.

Statistical analysis

Results from the current investigation were subjected to Analysis of Variance (ANOVA) by utilizing STATSTIX (Version 8.1) software as prescribed by Steel et al., (1997). The results were shown as the mean and standard deviation of the tomato sample. The mean of each test was different from the other. Analysis of variance (ANOVA) and Tukey's test with multiple comparisons was used to check the significant differences between treatments according to the guidelines proposed by Steel *et al.* (1997).

Performa for Sensory Evaluation of Black and green grapes jam

Name of Judge _____ **Date** _____

Treatments	Appearance	Color	Flavor	Aroma	Texture	Overall acceptability
Black grapes jam						
Green Grapes jam						

Signature_____

Instruction for judges:

Please follow the numerical scoring system with respect to the quality attributes studied using the following hedonic scale

Quality Description	Scale
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

*Performa used for sensory evaluation

RESULTS AND DISCUSSIONS

The current study was conducted in the Department of Food Science and Technology (FST) at MNS-University of Agriculture, Multan (MNS-UAM). The planned research work was performed in Microbiology Lab and Post-Harvest Lab.

In current study, two varieties of grapes were analyzed for the proximate composition and used for the product development. Furthermore, the prepared products were subjected for further analysis. The results obtained in the research work are discussed below.

Proximate composition

The fresh grape varieties were used to determine the nutrient distribution including the moisture content, ash, crude fat, crude fiber and crude protein according to the method described by Association of Official Analytical Chemists (AOAC, 2000).

Moisture (%)

The moisture content of grapes berries was measured through the differential method by using Hot air oven at temperatures about 105±5°C until constant weight achieved i.e., AOAC (2000) method.

The moisture content of black grapes was recorded 82.25% while the moisture content in green grapes was found to be 80.00%. This shows that the moisture content in black grapes is slightly higher than that of green grapes. This slight difference may arise due to environmental factors and difference in varieties.

Crude fat (%)

The grapes sample was subjected for the determination of crude fat (%) by using the Soxhlet System mentioned in Method of AOAC (2000).

The crude fat content in the black grapes was recorded 0.16% whereas in green grapes, the crude fat content was found to be 0.13%. The results declare that the fat content in both varieties of grapes i.e., NARC Black and Sundarkhani is quite low. The samples were subjected to fat determination as a whole fruit i.e., seed + pomace. However, black grapes contain a slightly higher fat content than green grapes.

Ash content (%)

In ashing, organic particles of the sample were burnt and the remaining content of the sample was inorganic known as ash content. Each variety of grapes was subjected for the ash analysis by following the method of AOAC (2000). The ash percentage in Black and Green grape varieties were found to be 0.81 and 1.01 respectively. The result shows that green grapes have a slightly higher ash content as compared to black grapes

Crude Fiber content (%)

The crude fiber content in both grape varieties was calculated following AOAC (2000) method. The results obtained suggested that the crude fiber content in the black grapes were 1.00% which is higher than crude fiber content in green grapes i.e., 0.37%.

Crude protein (%)

The crude protein contents were evaluated through the Kjeldahl apparatus according to the method suggested by AOAC (2000). The readings obtained as the results of crude protein percentage were 4.65% and 3.44% for black grapes and green grapes respectively. These results conclude that with a slight difference, black grapes contain more crude protein than green grapes.

Nitrogen free extract (NFE %)

The nitrogen free extract of moisture free sample was evaluated by subtracting the sum of proximate values from 100 using the following equation (Aina et al., 2012).

NFE% = 100 – (Moisture + crude fat + crude fiber + crude protein content + Ash content) %.

The Nitrogen Free Extract of black grapes was recorded 10.88 while that of green grapes was found to be 14.82.

Table 1. Proximate Composition of Black and Green grapes.

Parameters	Black Grapes	Green grapes
Moisture %	82.25	80.00
Crude Fat %	0.16	0.13
Ash %	0.81	1.01
Crude Fibre %	1.00	0.37
Crude Protein %	4.65	3.44
Nitrogen Free Extract	11.13	15.05

Physicochemical analysis

Following physicochemical analyses were carried out for each variety of grapes.

Total soluble solids (°Brix)

The total sugars in the grapes were determined using a

refractometer. The grape berries were homogenized by crushing. A single drop of homogenized grape was put on the refractometer and the reading it will gave, was recorded as total sugars (AOAC, 2000).

The results declared that the Black grapes had TSS value 22.42; whereas the TSS of green grapes was recorded 22.56. The results are shown as an average of three replications conducted for each variety. Although the difference between the total soluble solids of both varieties is quite low.

Titratable acidity

The titratable acidity of fruit was determined by taking 10ml of juice diluted with 10mL of water followed by titration with 0.1N NaOH (Lurie, 2007); Larriguadiere et al., 2002). The analysis was carried out in triplicates and the results were expressed as average of 3 replications. The results declared that the titratable acidity of Black and green grapes is 0.38 and 0.36 respectively. However, there is slight difference in the results of both varieties, these are due to difference in varieties and other components that make up the total composition.

pH

The determination of the pH of grapes juice was carried out through a pH meter (Dami, 2014). The pH electrode was initially calibrated and afterward, it was immersed into the sample solution of grapes juice until a constant reading was obtained. The pH of black grapes was recorded 3.80 and for green grapes, it was found to be 4.13.

Analysis of total phenolic content (TPC)

Grapes sample was analyzed for TPC by Folin-Ciocalteau's reagent as prescribed by the method of Kassim et al. (2013). The TPC of black and green grapes was calculated to be 87.07 and 79.67 respectively.

Table 2. Physicochemical composition of Black and Green Grapes.

Parameters	Black grapes	Green grapes
TSS	22.42	22.56
TA (%)	0.38	0.36
pH	3.80	4.13
TPC (mgGAE/100g)	87.07	79.67
DPPH (mgGAE/100g)	86.67	84.33

1, 2-Diphenyl-2-picrylhydrazyl (DPPH) assay

The calculation of free radical scavenging activity was carried out through spectrophotometer by the method proposed by Xu and Chang (2007). The values for free radical-scavenging activity of black grapes were calculated 86.67, while for green grapes, it was found to be 84.33.

Product development

Grape jam was developed for both varieties of grapes separately. The proximate, as well as physicochemical analyses, were carried out for the jams on zero, 15th, 30th, 45th and 60th day to check for differences in pH, TSS and acidity with respective methods whilst, for sensory evaluation 9-point hedonic scale was used (Lawless and Heymann, 2010). Later, statistical analysis was carried out to check significance level.

Sensory evaluation of product

The prepared jams were evaluated from 10 judges at the Department of Food Science and Technology MNS-University of Agriculture, Multan. The jams were assessed by the panelist according to the hedonic scale (Lawless and Heymann, 2010) where, 9 represented extremely like and 1 for extremely dislike. Sensory evaluation of jams was conducted to evaluate the quality characteristics including texture, color, taste, aroma and overall acceptability by following the methodology described by Wichchukit and O'Mahonyc (2015).

The results obtained from comparing both varieties are discussed below;

Appearance

Statistical values for appearance observation were observed as $p>0.05$ for storage whereas the combined interactive influence of treatment and storage was found non-significant. The mean value for the influence of treatment on appearance of grapes jam showed that black grapes jam has largest value 8.83±0.76 at 0 day of storage study as compression to green grapes jam where lowest value was observed 6.00±0.00 at 60th day of storage study.

Statistical results regarding appearance showed that the effects of varieties and storage of jam were highly significant and combined effects of varieties*storage were observed to be non-significant.

The effect of treatments (different varieties of grapes) on appearance of grapes jam indicated that the higher appearance value was observed in the black grapes jam with mean value of 8.83±0.76 and lowest 6.33±0.29. The highest appearance value of green grapes jam was

observed with mean value 8.33±0.58 and lowest 6.00±0.00. The interactive effect of treatments (different varieties of grapes) and storage times on appearance of grapes jam indicated that a higher value was observed in the black grapes jam at storage time of zero (0) day, 15th day, 30th day, 45th day and 60th day with mean value of 8.83±0.76, 8.17±0.29, 7.67±0.29, 7.00±0.00 and 6.33±0.29 respectively. These findings describe that appearance of grapes jam varies with the differences in varieties and decreases due to storage time.

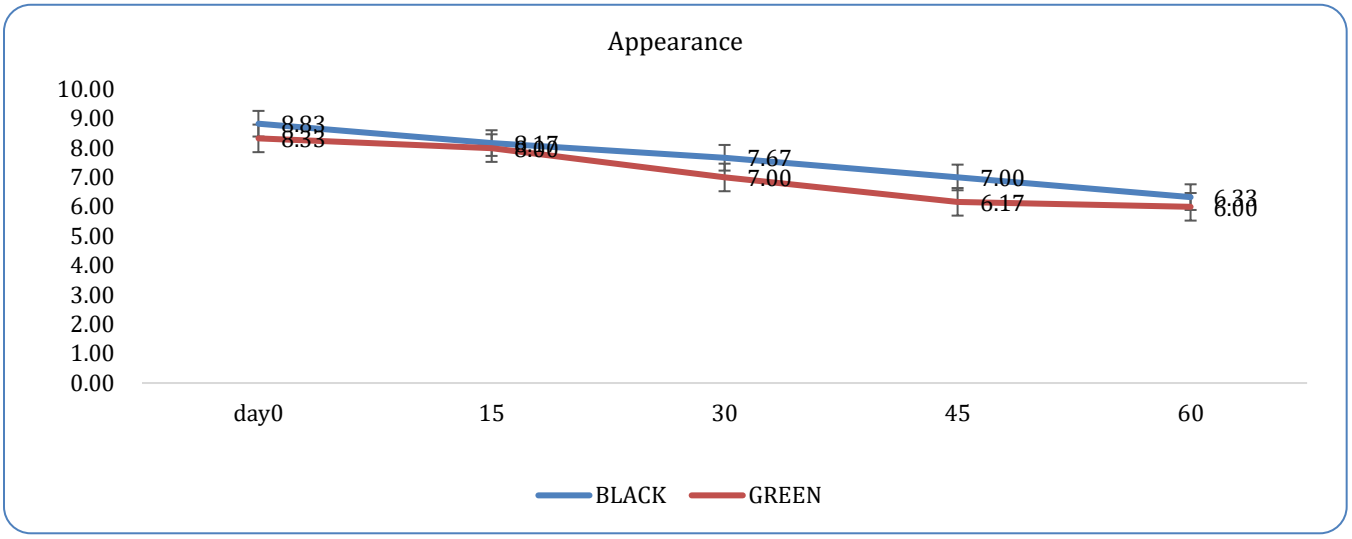

Figure 1. Appearance of jam.

Texture

Statistical values for texture observation were observed as p>0.05 for storage whereas the combined interactive influence of treatment and storage was found significant. The mean value for the influence of treatment (different varieties) on texture of grapes jam showed that Black grapes jam has higher value 8.50±0.50 at 0 day of storage study as compression to green grapes jam where lowest value was observed 5.33±0.58 at 30th day of storage study

Statistical results regarding texture showed that the effects of varieties of grapes and storage of jam were highly significant whereas the combined effects of varieties*storage were observed to be significant

The effect of treatments (different varieties of grapes) on texture of green grapes jam indicated that the highest texture was observed in with mean value of 7.67±0.58 and lowest 5.33±0.58 .The interactive effect of treatments (different grapes varieties) and storage times on texture of grapes jam indicated that significantly the higher value was observed in the black grapes jam at storage time of zero (0) day, 15th day, 30th day, 45th day and 60th day with mean value of 8.50±0.50, 8.17±0.29, 7.33±0.29, 6.83±0.29 and 6.17±0.29 .The recent result shows that texture of any grapes jam fluctuates due to the storage time as well as differences in varieties.

Color

Color is a major parameter of the product for the cogent assortment by the consumer side. The color of Grapes jam was affected by the natural color of varieties i.e., black and green.

Statistical values for color observation were observed as p>0.05 for storage whereas the combined interactive influence of treatment and storage was found non-significant. The mean value for the influence of storage on color of grapes jam showed that black grapes jam has highest value 8.33 ± 0.29 at zero day of storage study as compared to green grapes jam where lowest value was observed 6.17±0.29 at 60th day of storage study

Statistical results regarding color showed that the effects of varieties and storage of jam were observed to be highly significant while the combined effects of treatments*storage appeared to be non-significant. The effect of treatments (different varieties of grapes) on color of black grapes jam indicated that the highest color was observed with mean value of 8.33 ± 0.29 and lowest 6.50±0.50. Highest value for color of green grapes jam was 7.67±0.29 while lowest value emerges 6.17±0.29.

The interactive effect of treatments (different varieties) and storage times on color of grapes jam indicated that the higher value was observed in the black grapes jam at storage time of zero (0) day, 15th day, 30th day, 45th day and 60th day with mean values of 8.33 ± 0.29, 7.67 ± 0.29, 7.17±0.29, 7.00± 0.00 and 6.50±0.50 respectively. These findings show that color of jam is affected by the varieties and decreased due to storage time.

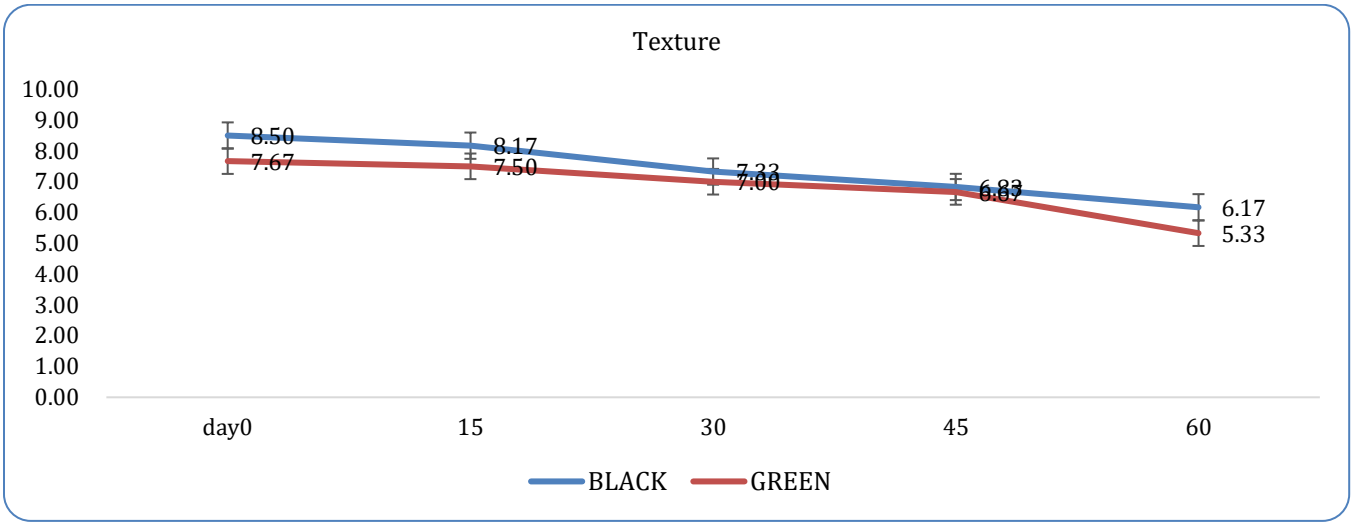

Figure 2. Texture of jam.

Flavor

Statistical values for flavor observation were observed as p>0.05 for storage whereas the combined interactive influence of treatment and storage was found significant. The mean value for the influence of treatment on flavor of grapes jam showed that Black grapes jam has largest value 8.50±0.50 at 0 day of storage study as compression to 60th day where the lowest value 60.00±0.50 was observed for black grapes. Statistical results regarding flavor showed that the effects of varieties and storage of jam were observed to be highly significant, whereas, the combined effects of varieties*storage were significant. The effect of treatments (different grape varieties) on flavor of grapes jam indicated that the highest flavor was observed in the black grapes jam with mean value of 8.50±0.50 and lowest 60.00±0.50, whereas the highest and lowest values for green grapes jam were observed 8.17±0.29 and 6.33±0.29 respectively.

The interactive effect of treatments (different grapes varieties) and storage times on flavor of grapes jam indicated that significantly the higher value was observed in black grapes jam at storage time of zero (0) day, 15th day, 30th day and 45th day with mean value of 8.50±0.50, 8.17±0.29, 7.67±0.29 and 7.17±0.29 respectively. On 60th day, the higher value was observed for green grapes jam with mean value 6.33±0.29. These finding show that flavor of grapes jam is affected by varieties and decreases with storage time.

Aroma

Statistical values for aroma of both grape jams were observed as p>0.05 for storage whereas the combined interactive influence of treatment and storage was found non-significant. The mean value for the influence of treatment on aroma of grapes jam showed that black grapes jam has largest value 9.00±0.00 at zero day of storage study as compression to green grapes jam where lowest value was observed 6.50±0.29 at 60th day of storage study

Statistical results regarding aroma of grapes jam showed that the effects of varieties and storage of jam are highly significant and combined effects of varieties*storage on aroma of grapes jam were observed to non-significant

The effect of treatments (different varieties) on aroma of grape jam indicated that the highest value for black grapes jam was observed with mean value of 9.00±0.00 and lowest 7.33±0.29, whereas for green grapes the highest and lowest values for aroma were observed to be 8.50±0.50 and 6.50±0.29 respectively

The interactive effect of treatments (different varieties of grapes) and storage times on aroma of grapes jam indicated that the higher value was observed in the black

grapes at storage time of zero (0) day, 15th day and 30th day, 45th day and 60th day with mean value of 9.00±0.00, 8.50±0.50, 7.67±0.50, 7.33±0.58 and 7.33±0.29 respectively These findings show that the aroma of grapes jam decreases gradually with storage time.

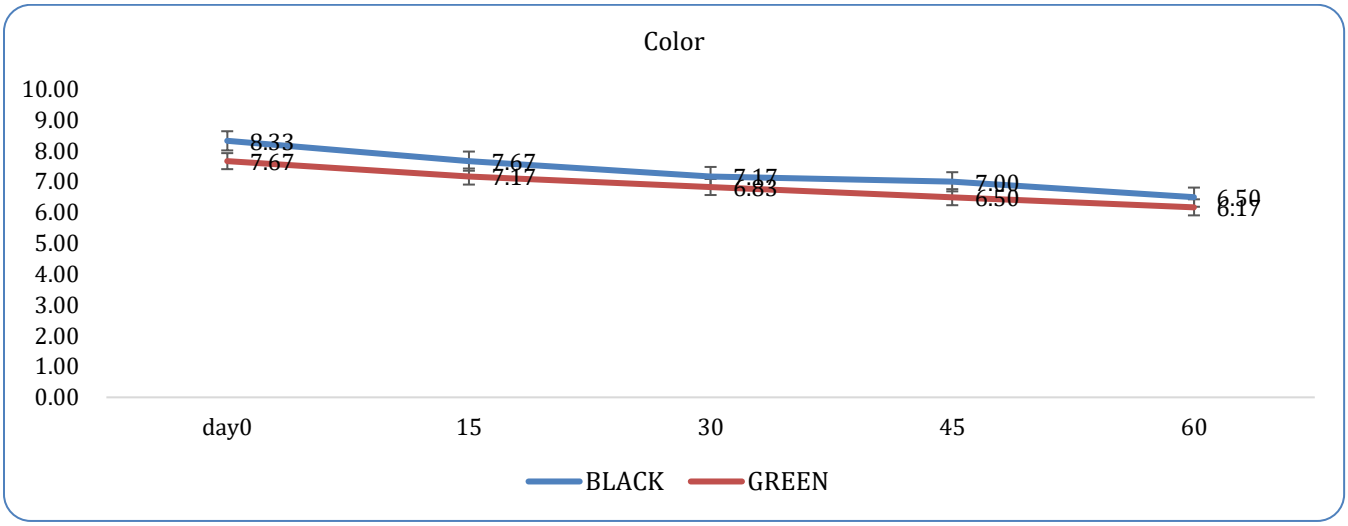

Figure 3. Color of jam.

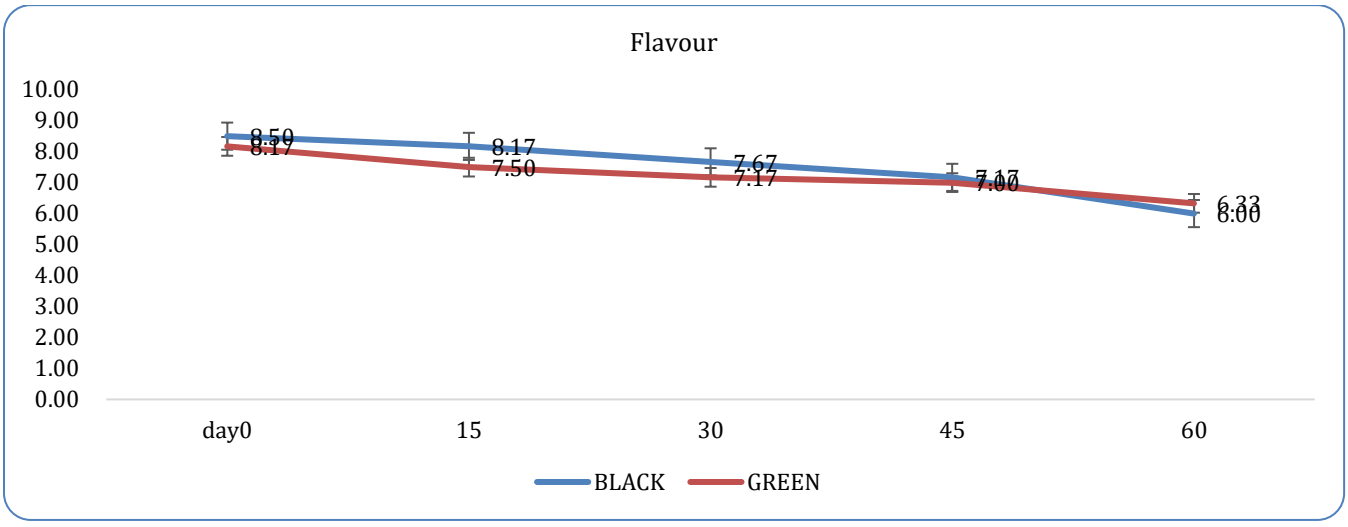

Figure 4. Flavor of jam.

Overall acceptability

Statistical values for overall acceptability of both grape jams were observed as $p>0.05$ for storage whereas the combined interactive influence of treatment and storage was found significant. The mean value for the influence of treatment on over all acceptability of grapes jam showed that black grapes jam has largest value 9.17±0.29 at zero day of storage study as compression to green grapes jam where lowest value was observed 5.30±0.58 at 60th day of storage study. Statistical results regarding over all acceptability showed that the effects of varieties and storage of jam are highly significant and combined effects of varieties*storage on over all acceptability were observed to significant

The effect of treatments (different varieties) on over all acceptability of grape jam indicated that the highest overall acceptability of black grapes jam was observed with mean value of 9.17±0.29 and lowest 7.00±0.00, whereas for green grapes the highest and lowest overall acceptability values were observed to be 8.33±0.58 and

5.30±0.58 respectively

The interactive effect of treatments (different varieties of grapes) and storage times on over all acceptability of grapes jam indicated that significantly the higher value was observed in the black grapes at storage time of zero (0) day, 15th day and 30th day, 45th day and 60th day with mean value of 9.17±0.29, 8.33±0.58, 7.50±0.87, 7.50±0.50 and 7.00±0.00 respectively. These findings show that the overall acceptability of grapes jam is gradually reduced.

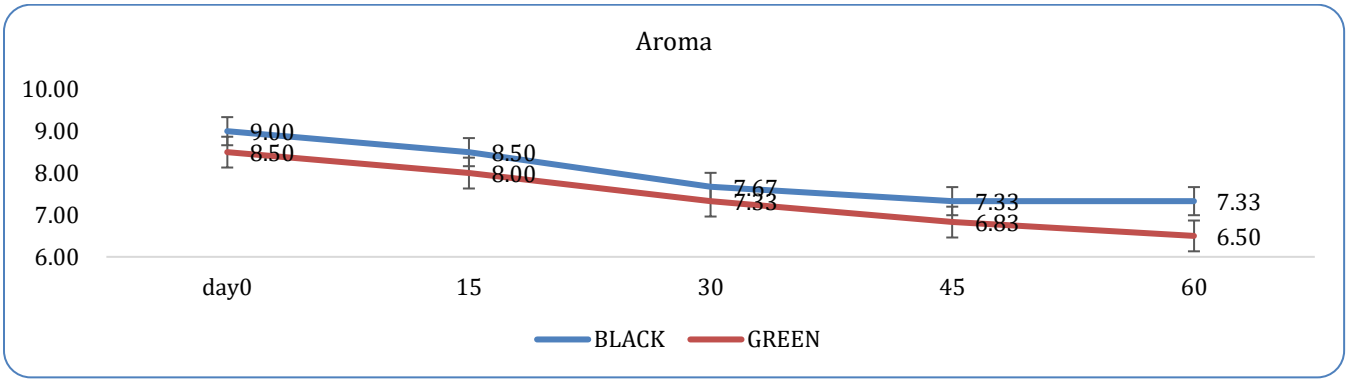

Figure 5. Aroma of jam.

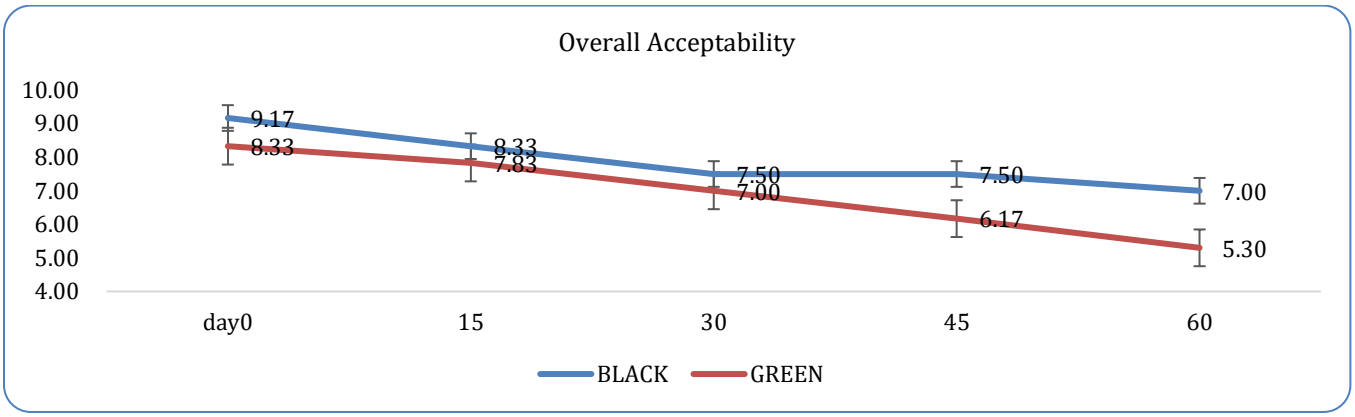

Figure 5. Overall acceptability of grape jam.

Chemical and physical analysis

The physicochemical analyses of the jams of both grape varieties were carried out on zero, 15th, 30th, 45th and 60th day to check for differences in pH, TSS and acidity with respective methods.

Total Soluble Solids

Statistical values for TSS observation were observed as $p>0.05$ for storage where the combined interactive influence of treatment and storage was found non-significant. The mean value for the influence of treatment on TSS of grapes jam showed that Black grape jam has largest value 68.32±1.97 (ºBrix) at 15th day of storage study as compared to green grapes jam where lowest value was observed 60.53±2.20 (ºBrix) at 60th day of storage study. Statistical results regarding total soluble solids showed that the effects of grape varieties have significant effects, storage of jam has highly significant effects, and the combined effects of varieties × storage of jam on total soluble solid were observed to be non-significant.

The effect of treatments (different varieties) on TSS of grapes jam indicated that a higher TSS was observed in the black grapes jam with mean value of 66.12 (ºBrix) and lower in green grapes jam with the mean value 65.83 (ºBrix). The interactive effect of treatments (different varieties) and storage times on TSS of grapes jam indicated that non-significantly the higher value was observed in the black grapes jam at storage time of 30th, 45th, and 60th day with mean value of 68.30±0.74

(ºBrix), 64.37±0.50 (ºBrix) and 61.35±1.73 (ºBrix) respectively, whereas the green grapes jam showed higher values at storage times of zero and 15th day with mean values 68.73±1.38 (ºBrix) and 68.51±0.26 (ºBrix). The results of my study show that TSS of grapes jam decreases with storage time.

pH

Statistical values for pH observation were observed highly significant for storage whereas for treatment and the combined interactive influence of treatment and storage were found insignificant. The mean value for the influence of treatment on pH of grape jam showed that both the jams have largest mean value 3.67 ±0.02 at zero (0) day as compression to where lowest mean value was observed in both the jams 3.52±0.01 at 30th day of storage. Statistical results regarding pH of jam showed that the effects of treatments × storage of jam on pH were observed to be highly significant, whereas the individual effects of treatments as well as storage were observed non-significant. The influence of treatments (Black and green varieties) on pH of jam indicated that the highest pH was observed in the jam with mean value of 3.67± 0.03 and lowest 3.52±0.02. The interactive effect of treatments (different grape varieties) and storage times on pH of grape jam indicated that the highest value was observed in both the jams at storage time of zero (0) day. On 15th, 30th, and 45th days the values remained 3.62±0.04, 3.59±0.01 and 3.55±0.01 respectively for black grape jam, while 3.67 ±0.03, 3.64±0.02 and 3.56 ±0.02 for green grape jam. On 60th day, the values remained same for both the jams (3.52±0.01). The results of my show that the pH of grapes jam decreases with storage time irrespective of varieties used.

Acidity

Statistical values for acidity observation were observed as for both treatment and storage whereas the combined interactive influence of storage was found ($p<0.05$). The mean value for the influence of treatment (varieties) on acidity of grape jam showed that both the varieties have largest mean value 0.73±0.00 from 30thday to 60th day as compression to where lowest mean value was observed in black grapes 0.71±0.00 at zero (0) day of storage. Statistical results regarding pH of jam showed that the effects of storage were observed to be significant, whereas the effect of treatments (different grape varieties), and combine effects of treatments × storage of jam on acidity were observed to be non-significant. The influence of treatments (different grape varieties) on acidity of grape jam indicated that the acidity in the both varieties jams was same with mean value of 0.73±0.01from day 45th to 60th and the lowest value was observed for black grape jam 0.71±0.00 on 0 day. The interactive effect of treatments (different varieties) and storage times on acidity of grapes jam indicated that significantly the highest value was observed in the green grapes jam at storage time of zero (0) day with mean value of 0.72± 0.00. The results of my study show that acidity of grape jam slightly increases with storage time.

CONCLUSION AND RECOMMENDATIONS

Grapes are perishable commodities with substantial nutritional profile and health benefits. Post-harvest shelf life of grapes is too short so development of value-added product like jam will be a great approach to commercialize. Grapes by-products are very in market shelves including resins or juices. Development of jam from best selected grape variety will add innovation to the product as consumer is much more concern about health. Current study showed that physicochemical properties of black and green grapes were significantly different and will be suitable for product development. Research institutes (educational or industrial) can assist in developing novel products and managing research activities for students. Breeders can develop new cultivars that have maximum required traits such as increased sugar content, vitamin C and other nutritional components.

Products trial with different concentrations of ingredients at institute level by researcher can help in commercialization at industrial level. As a result, we can conclude that grapes and its jam can be a most healthful approach to combat food security issues in Pakistan.

REFERENCES

Aina, V. O., B. Sambo, A. Zakari, H. M. S. Haruna, K. Umar and R. M. Akinboboye. 2012. Determination of nutritional and antinutritional content of Vitis vinifera (grapes) grown in Bomo (Area C) Zaira, Nigeria. Advance Journal of Food Science and Technology, 4: 225-28.

AOAC. 2000. Official Methods of Analysis of Association of Official Analytical Chemist. International. In:

Horwitz, W. (ed.), 18th edition. AOAC Press, Arlington, VA, USA. Place Published.

Dami, I. 2014. Determining grape maturity and fruit sampling. Columbos, OH: Ohio State University Extension..[veebileht] https://ohioline. osu. edu/factsheet/HYG-1436 (12.04. 2020).

Lawless, H. T. and H. Heymann. 2010. Sensory evaluation of food: principles and practices. Springer.

Lurie, S. 2007. Regulation of ethylene biosynthesis in fruits by aminoethoxyvinyl glycine and 1-methylcyclopropene. Place Published. pp.31-41.

Madhu, C., K. M. Krishna, K. R. Reddy, P. J. Lakshmi and E. K. Kelari. 2017. Estimation of crude fibre content from natural food stuffs and its laxative activity induced in rats. International Journal of Pharma Research and Health Sciences, 5: 1703-06.

OIV. 2019. Statistical Report on World Vitiviniculture. Place Published.

PBS. 2017. Pakistan Statistical Yearbook. 2017. Pakistan Bureau of Statistics. 1: 43. Place Published.

Pop, A., S. Muste, A. Păucean, C. Pop, L. Salanţă, S. Man and A. MureŞan. 2015. Jam Processing on Concord Grapes Variety Polyphenols and Antioxidant Capacity. Bulletin UASVM Food Science and Technology, 72: 2.

Razzaq, K., A. S. Khan, A. U. Malik and M. Shahid. 2013. Ripening period influences fruit softening and antioxidative system of 'Samar Bahisht Chaunsa' mango. . Scientia Horticulturae, 160: 108-14.

Steel, R. G. D., J. H. Torrie and D. A. Dickey. 1997. Principles and procedures of statistics; a biometrical approach. 3rd edition. McGraw-Hill, Boston. Place Published.

USDA. 2009. FAS Quarterly Reference Guide to World Horticultural Trade: Production, supply, and distribution of key commodities. USDA, Foreign Agricultural Service Circular Series, 1–4 September: 4. Place Published.

Wichchukit, S. and M. O'Mahony. 2015. The 9-point hedonic scale and hedonic ranking in food science: some reappraisals and alternatives. Journal of the Science of Food and Agriculture, 95: 2167-78.

Xia, E.-Q., G.-F. Deng, Y.-J. Guo and H.-B. Li. 2010. Biological activities of polyphenols from grapes. International journal of molecular sciences, 11: 622-46.

Xu, B. J. and S. Chang. 2007. A comparative study on phenolic profiles and antioxidant activities of legumes as affected by extraction solvents. Journal of food science, 72: S159-S66.