Nutritional and Genetically Studies on Some Squash Varieties

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Abstract: In this research, the role of the dried peels of some squash varieties as antioxidants when added to the processed cake were discussed. The cake contents from sugar and the sensory characteristics were recorded under the effect of different peels additions. Also, the four varieties were crossed to obtain 6 F_1 hybrids according to a half diallel crosses mating design. The results showed that different squash peels improved their acceptability and their sugar contents. On the other hand, the amounts of heterosis versus mid-parents showed highly significant values for all studied traits. The estimates of heterosis versus the better parent showed highly significance for most studied traits. None of the hybrids exhibited maximum heterosis for all the traits, but significant and desirable level of heterosis over mid-parents and better parent was obtained in several hybrids for the yield and yield component traits. Four squash varieties belong to the species (*Cucurbita pepo*, L.), were: Eskandarani (P_1); Siyah Kabuk (P_2); Erbil Garden (P_3) and Zucchino Alberallo Di Sarzana (P_4) used in this study. The seeds of these varieties were obtained from different countries: (P_1) from Egypt; (P_2) from Turkey; (P_3) from Iraq and (P_4) from Italy.
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1. Introduction

Cucurbitaceae is one of the most important botanical families for human use as favorable vegetable crop. Thus, summer squash (*Cucurbita pepo*, L.) is considered to be one of the most popular vegetable crops grown in Egypt. It is known as a vegetable marrow and is called also Kosa by the Egyptian. In Egypt, there are only one local cultivar of squash called Eskandarani, which is high yielding and satisfies both the producer and consumer.

Lapinig (1972) Processed for converting pumpkin meat into a flavored sweet and sour pickle product has been patented. The process includes chilling the pumpkin in brine with ice at 4.4-7.2oC for ≥5 h to achieve crispness and subsequently combining with sugar, vinegar and spices. The marmalade from fluted pumpkin fruit has no significant differences in sensory attributes like taste, consistency, spread ability and overall acceptability when compared with commercial orange marmalade. Pumpkin seeds have many health benefits due to lower cholesterol and antidepressant qualities (**Egbekun *et al.,* (1998)** and **Dhiman *et al.*, 2009)**.

The varieties ‘Vegetable Spaghetti’ and ‘Yellow Crookneck’ are more suitable whereas, ‘Buttercup’ had the highest nutritional quality characteristics. Jam prepared from fresh pulp without pectin addition has yellow color, elastic gel texture and flat flavor and is well accepted by panelists **(Samaha (2002)**.

Pumpkin powder contained appreciable amount of fiber, minerals and β-carotene (**Kundu *et al.,* 2014).**

In squash and other cucurbits, heterosis was utilized aiming to increase the productivity and quality of other traits. Many investigators studied heterosis on vegetative traits among them; **Al-Ballat (2008)** found in summer squash that heterosis over the mid-parents was highly significant with negative values for number of days to first female flower and number of nodes to first female flower. Heterosis values based on the better-parent was significant or highly significant with negative values for number of days to first female flower while he found insignificant heterosis for number of nodes to first female flower.

Heterosis over the mid-parents was significant or highly significant with positive values for stem length, number of male flowers/plant, number of female flowers/plant and sex ratio. He studied also heterosis over the better parent; it was highly significant with positive values for stem length. Both positive and negative heterosis was observed for different qualitative and quantitative characters in F_1hybrids of sweet gourd. None of the hybrids exhibited maximum heterosis for all the traits, but significant and desirable level of heterosis over mid parent and better parent was obtained in several hybrids for the different traits (**Al-Araby, 2010** and **Jahan *et al.*, 2012).**

Abdein (2016) studied that the performance of most $F_{1,1r}$ hybrids were variable and the results cleared that there is no hybrid gave the best results for all studied traits. While, most of F_1 hybrids had the highest means of most studied traits compared with the parental varieties. He reported that the (Eskandarani) variety was the highest for number of fruits per plot (No.F./Pt.), fruits yield per plot (F.Y./Pt.kg) and fruits yield per plant (F.Y./P.kg). Also, he observed that (Zucckinostriatod' Itali) was the highest for fruit length (F.L.cm) and fruit shape index (F.Sh.I.).

2. Materials and Methods

Plant materials:

The plant materials used in the experiment included four squash varieties belong to the species (*Cucurbita pepo*, L.). These varieties were: Eskandarani (P_1); Siyah Kabuk (P_2); Erbil Garden (P_3) and Zucchino Alberallo DiSarzana (P_4). The symbols of squash varieties and their origins showed in **Table 1**.

Table 1: The symbols of the squash varieties and their origins.

No.	Symbol	Name	Origin
1	P_1	Eskandarani	**Egypt**
2	P_2	SiyahKabuk	**Turkey**
3	P_3	Erbil Garden	**Iraq**
4	P_4	Zucchino Alberallo DiSarzana	**Italy**

Cake Materials:

1-2 cups of raw flour to make cake: 2 cups flour - 1/2 cup butter - 1/4 cup sugar powder - 4 eggs - 3 tablespoons baking powder - vanilla - 1/2: 3/4 cup milk. (**Fennema *et al*., 2004**).

Preparation and drying of peels:

The fruits were peeled after cleaning well and then sliced into thin peels and dried in the oven drying at 60° C for 2-4 hours according to the different varieties of peels. **Krokida *et al.*,2003.**

Cake Making:

1. Sampling of the control cake was prepared (**Hamlyn, 1989**).

2. Cake was made with the addition of peels of four varieties, individually each time by 5g and another frequency of 10g. These quantities are divided by the weight of the flour used in preparation each time.

Sensory characteristics:

Sensory characteristics of the cake treated with the peels isolated from different squash varieties which are color, taste, smell, texture and crispness.

Yield and yield component traits:

The experimental design was the Randomized Complete Blocks Design (RCBD) with three replications. Data were recorded for seven traits: fruit length (F.L.cm); fruit diameter (F.D.cm); fruit shape index (F.Sh.I.); Total Soluble Solid% (T.S.S%); weight of fruit (W.F.g); number of fruits per plant (No.F./P.) and fruit yield per plant (F.Y./P.kg). Differences among genotypic means for all studied traits were tested for significance according to F-test. The form of analysis of variance and the expectations of mean squares were as outlined by **Steel and Torrie (1960).**

The four varieties were crossed to obtain 6 F_1 hybrids according to a half diallel crosses mating design (**Griffing, 1956) and Matzinger & Kempthorne 1956).**

The experimental design was the Randomized Complete Blocks Design (RCBD) with three replications in privet farm: Alktatba (Menofia governorate), Egypt at the summer season 2015.

The amounts of heterosis were determined as the percentage deviation from the means of the F_1 hybrids from the average of all parents (mid-parents) or the better parent (**Cockerham, 1963)**.

The amounts of heterosis were determined as the deviation of the mid-parents and the better parent as follows:

1. Heterosis from the mid-parents:

$$H^{(\bar{F}_1,\ \overline{M.P.})}\% = \frac{(\bar{F}_1 - \overline{M.P})}{\overline{M.P.}} \times 100$$

2. Heterosis from the better parent:

$$H^{(\bar{F}_1,\ B.P.)}\% = \frac{(\bar{F}_1 - B.P)}{B.P.} \times 100$$

3. Results and Discussion

Effect of the addition of dried squash peels to cakes on the contents from sugar:

Data presented in **Table (2)** showed a significant increase in the sugar content in all cake samples treated with each one from the four varieties in 5 and 10g/250g flour. The best results were achieved when adding the third peel then the second peel with 10 and 5g/250g flour, respectively.

The contents from sugars achieved were the same when adding the first and second variety peels with percentages 10 and 5 and g/250g flour, respectively. This is confirmed that sugars in the second variety peels were higher in compared to the first variety **(Guine *et al*., 2011)**.

On the other hand, the results achieved by the first variety peels were better than the fourth variety peels, whereas the proportion of sugars achieved were the same when added with 5 and 10g/250g flour, respectively (**Beradini *et al*., 2005).**

Generally, the sugar levels of the cake compared to the control were not affected by duplicating the additions from each peels. It means that by more additions, the peels were converted to another compounds **(Dhiman *et al.* 2009)**.

Table (2): The influence of dried squash peels on processed cake content from sugar.

Cake content from sugar								
Peels additives	P_1		P_2		P_3		P_4	
Control	5g/250g flour	10g/250g flour	5g/250g flour	10g/250g flour	5g/250g flour	10g/250g flour	5g/250g flour	10g/250g flour
14	20	21	21	23	22	24	19	20

Sensory characteristics of cake treated with squash peels:

Data listed in **Table (3)** show the sensory characteristics of the cake treated with the peels isolated from different squash varieties which are color, taste, smell, texture and crispness.

1-Color:

The best results from the color were obtained with the cake samples treated with the peels of second and third varieties when added with 10g/250g flour in compared to the samples with peels of other varieties and control.

Meanwhile, the color of cake samples treated with the second and the fourth varieties in 5g and 10g/250g flour, respectively confirmed that the strength of the second variety in improving the color of cake samples.

On the other hand, The peels obtained from the first and third varieties have nearly effects in improving the cake color samples when added with 5 and 10g/250g flour, respectively.

2 -Taste:

The taste in cake samples treated with peels of all tested squash varieties was better than the control sample, especially when they added in the percentages of 5 and 10g/250g flour.

3-Smell:

The best smell observed clearly by adding the second variety peels with 10g/250g flour when compared with all other treated cake samples and the control.

On the other hand, the peels of the first variety gave recommended effect in cake smell especially when added with 5g/250g flour in compared to control.

4 -Texture:

The best results in cake texture were achieved with the cake samples treated with third variety peels with 10g/250g flour followed by the second variety peels with 5 and 10g/250g flour when compared to all other cake samples and the control. Also, the addition from the peels of first variety with 5g/250g flour was better than its addition with 10g/250g flour in improving the cake texture in compared with the control.

5 -Crispness:

The preferred cake crispness was obtained by the addition of 5 and 10g/250g flour from peels of the third and first varieties, respectively in compared to all other samples and the control.

Generally, all treated cake samples with different percentages from dried peels of four squash varieties have sensory characteristics better than the control sample and there were not rejected samples recorded by the tasters.

Sample pictures of cake treated with the peels from squash varieties compared with control are showed in Figure 1.

Table (3): Sensory properties in the cake treated with squash peels.

Peels Additives	**Sensory qualities**	**Color**	**Taste**	**Smell**	**Texture**	**Crispness**
Control		8.4±1.58	7±0.82	9±0.82	8.5±1.08	8.1±1.1
5g/250g flour	**P_1**	6.1±0.9	8.2±1.62	7.5±0.97	8.1±1.2	6.8±1.03
	P_2	8±0.82	8.6±1.07	7.7±0.67	8.8±0.92	6.4±1.07
	P_3	6.8±0.79	8.6±1.17	6.5±0.85	7.9±1.1	8.4±1.07
	P_4	6.3±0.67	7.9±0.74	6±0.7	7.5±0.85	7.6±1.07
10g/250g flour	**P_1**	7.1±0.88	9.1± 0.9	6.7±0.67	6.3±0.95	8.7±1.2
	P_2	9.2±0.79	8.7±1.06	9.1±0.99	8.5±1.27	6.4±1.07
	P_3	9.3±0.67	9.3±0.7	7.2±1.03	9.1±0.99	6.4±0.84
	P_4	8±1.15	8.2±0.79	8.1±0.99	6.3±0.95	6.6±0.97

Yield and yield component traits:

Squash varieties possess a wide range of variation for yield and yield component traits. Vegetable breeders usually use this variability as a tool to improve squash varieties through selection programs or to produce F_1 hybrids to make use of hybrid vigor phenomena and to obtain highest yielding hybrids.

The mean performance of all genotypes:

Performances of studied genotypes should be studied for yield and yield component traits.

The means of yield and yield component traits were obtained four parental varieties and6 F_1 hybrids, the results are presented in **Table 4.** The results cleared that the obtained mean values showed that there was no single parent exceeded all the other parents for all studied yield traits.

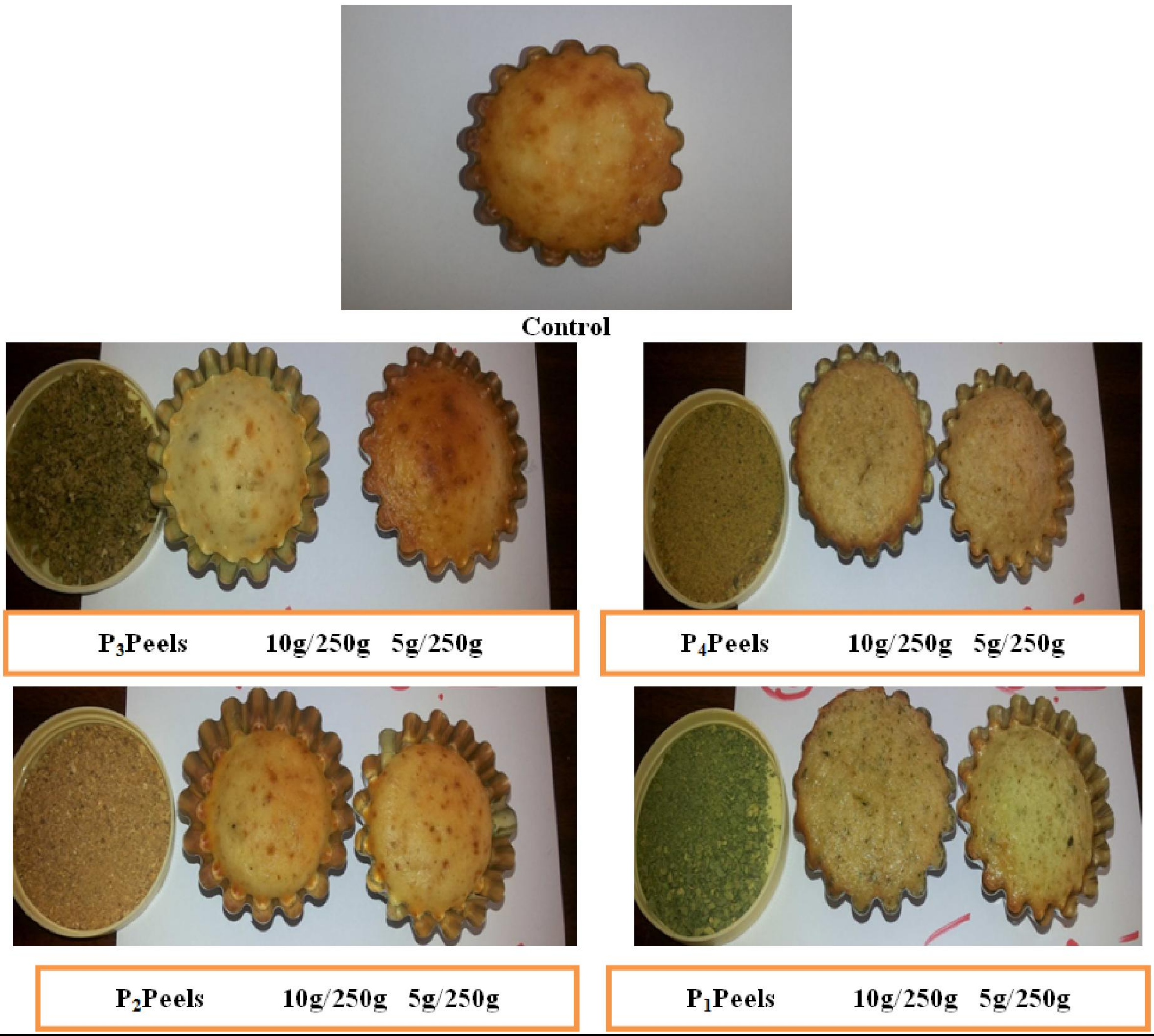

Fig 1: Samples of cake treated with the peels from squash varieties.

It is also regarded from the results that the parental variety P_1 was the highest parent for F.L.cm.; F.Sh.I. and F.Y./P.kg as well as P_2 was the highest parent for F.D.cm; W.F.g and T.S.S.%**.** While, the parental variety P_3 was the highest parent for No.F./P., but it was the lowest parent for F.D.cm and W.F.g traits.

The parental variety P_4 was the lowest variety for T.S.S.%**.** It is also, noticed from the same **Table** that the differences between the means of the lowest parent and the highest were always significant indicating the presence of genetic differences between the four varieties.

In general, these results suggested that there was a wide range of variation among varieties for all studies traits. The results indicated that the highest F_1 hybrid for fruit yield per plant (F.Y./P.kg) was $P_2 \times P_3$ with the mean of 5.536. On the other hand, F_1 hybrid

$P_1 \times P_3$ was the lowest (undesirable) with the mean of 4.207.

The results cleared that the means of F_1 hybrids were ranged from 9.12 to 14.71cm; 3.13 to 5.84cm; 1.57 to 4.33; 3.86 to 7.51%; 123.33 to 219.06g; 23.68 to 36.54fruits, 4.207 to 5.536kg for F.L.cm; F.D.cm; F.Sh.I.; T.S.S.%; W.F.g; No.F./P. and F.Y./P.kg, respectively.

Concerning the performances of F_1 hybrids for yield and yield component traits, the results indicated that the magnitudes of the means of F_1 hybrids were close to each other for most studied traits. At the same time, when hybrids were compared with each other, the results showed the presence of significant differences for many traits. It is also clear that some F_1 hybrids for yield and yield component traits exceeded the better parent. Whereas, it would be expected that there were quite heterosis values versus the mid-parents.

These results were in agreement with the results obtained by **Abdein (2005)** he evaluated 12 F_1 hybrids among four varieties of summer squash and estimated the performances of F_1 and F_{1r} hybrids for yield and its component traits, the results indicated the magnitudes of yield and its component traits.

Heterosis:-

An important goal of most vegetable breeding programs is planted to increase the yielding capacity for the crops. This goal is achieved either by improving the characteristics of the vegetable crops through selection programs or through hybridization to produce superior F_1 hybrids.

In order to study heterosis as phenomena in squash, the averages of all hybrids were compared with the averages of all hybrids versus the mid-parents ($H_{M.P.}$%) for all studied traits. This type of comparison would eliminate bias for certain specific hybrid which, indeed, would be superior to the best of the F_1 hybrids and to its better parent ($H_{B.P.}$%). The significance of heterosis was obtained for each comparison by comparing the differences against the least significant differences (L.S.D.) values.

Table 4: The mean performances of four parental varieties and F_1 hybrids for yield and yield component traits.

Genotypes	Yield and yield component traits						
	F.L.cm	F.D.cm	F.Sh.I.	T.S.S.%	W.F.g	No.F./P.	F.Y./P.kg
P_1	12.87 ^{H}	3.05	4.23 ^{H}	3.29	114.07	22.82	2.668 ^{H}
P_2	4.81 ^{L}	7.21 ^{H}	0.67 ^{L}	5.59 ^{H}	130.24	16.04	2.153 ^{L}
P_3	10.61	2.71 ^{L}	3.91	3.47	91.76 ^{L}	24.75 ^{H}	2.349
P_4	8.80	6.39	1.38	2.56 ^{L}	141.74 ^{H}	15.76 ^{L}	2.268
$P_1 \times P_2$	9.43	5.77	1.64	6.14	198.16	25.45	4.961
$P_1 \times P_3$	14.02	3.26	4.29	4.36	123.33 ^{L}	36.54 ^{H}	4.207 ^{L}
$P_1 \times P_4$	13.54	3.13 ^{L}	4.33 ^{H}	3.68 ^{L}	209.12	27.92	5.534
$P_2 \times P_3$	9.72	5.62	1.73	7.51 ^{H}	214.08	27.07	5.536 ^{H}
$P_2 \times P_4$	9.12 ^{L}	5.84 ^{H}	1.57 ^{L}	6.34	219.06 ^{H}	23.68 ^{L}	4.675
$P_3 \times P_4$	14.71 ^{H}	4.66	3.16	3.74	191.69	26.17	4.823
L.S.D. $_{0.05}$	0.505	0.450	0.372	0.247	6.225	2.564	0.434
L.S.D. $_{0.01}$	0.683	0.608	0.503	0.334	8.414	3.466	0.587

H= The highest value. L= The lowest value.

1. Heterosis for mid-parents ($H_{M.P.}$%):-

Heterosis percentage of the 6 F_1hybrids relative to mid-parents for the yield and yield component traits are presented in **Table 5**. The results indicated that the values of heterosis over the mid-parents for F_1 hybrids for were ranged from 6.66 to 51.57% for F.L.cm; -33.64 to 13.24% for F.D.cm; -33.11 to 54.40% for F.Sh.I.; 24.16 to 65.66% for T.S.S.%; 19.83 to 92.86% for W.F.g; 29.21 to 53.63% for No.F./P. and 67.67 to 145.95% for F.Y./P.kg. These results were in agreement with the results obtained by **Marie *et al.*, (2012),** in squash studied heterosis over mid-parents was evident in all yield components, the hybrid (IL3×IL6) exhibited 57.57% for fruit number per plant. Four hybrids had positive and high significant standard heterosis for plant yield, the hybrids (IL6×IL7) and (IL3×IL6) had maximum values (32.38 and 28.68%), respectively.

Generally, all the 6 F_1hybrids exhibited positive (desirable) highly significant estimates for other studied traits.

Also, similar results were obtained by These results were in agreement with the results obtained by **Al-Araby, (2010); Jahan *et al.*, (2012)** and **Abdein (2016).**

Table 5: Heterosis relative to mid-parents ($H_{M.P.}$%) for yield and yield component traits.

Hybrids	Yield and yield component traits						
	F.L.cm	F.D.cm	F.Sh.I.	T.S.S.%	W.F.g	No.F./P.	F.Y./P.kg
$P_1 \times P_2$	6.66** L	12.48**	-33.11** L	38.18**	62.21**	30.99**	105.79**
$P_1 \times P_3$	19.41**	13.31** H	5.59	28.87**	19.83** L	53.63** H	67.67** L
$P_1 \times P_4$	24.95**	-33.64** L	54.40** H	25.81**	63.49**	44.70**	124.21**
$P_2 \times P_3$	26.12**	13.24**	-24.36**	65.66** H	92.86** H	32.71**	145.95** H
$P_2 \times P_4$	34.02**	-14.12**	53.23**	55.66**	61.08**	48.89**	111.51**
$P_3 \times P_4$	51.57** H	2.49	19.30**	24.16** L	64.19**	29.21** L	108.89**
L.S.D. $_{0.05}$	0.437	0.390	0.322	0.214	5.391	2.220	0.376
L.S.D. $_{0.01}$	0.591	0.527	0.436	0.289	7.286	3.001	0.508

*,** Significant and highly significant at 0.05 and 0.01 probability levels, respectively.
H= The highest value. L= The lowest value.

2. Heterosis for better parent ($H_{B.P.}$%):-

Heterosis percentage of the 6 F_1 hybrids relative to better parent for the yield and yield component traits are presented in **Table 6**.

The results indicated that the values of heterosis over the better parent to F_1 hybrids were ranged from -26.75 to 38.69% for F.L.cm; -50.99 to 7.11% for F.D.cm; -61.28 to 13.65% for F.Sh.I.; 7.77 to 34.27% for T.S.S.%; 8.11 to 64.37% for W.F.g; 5.75 to 47.65% for No.F./P. and 57.65 to 135.66% for F.Y./P.kg. These results were in agreement with the results obtained by **Anita and Ram (2009)** they found on cucumber that the standard heterosis for yield and its component traits in nine F_1 hybrids developed from nine parents and two checks indicated that some outstanding F_1 hybrids.

Similar results were obtained by and agreement with the results obtained by **Abdein (2005); Al-Araby, (2010); Jahan *et al.*, (2012)** and **Abdein (2016).**

Table 6: Heterosis relative to better parent ($H_{B.P.}$%) for yield and yield component traits.

Hybrids	Yield and yield component traits						
	F.L.cm	F.D.cm	F.Sh.I.	T.S.S.%	W.F.g	No.F./P.	F.Y./P.kg
$P_1 \times P_2$	-26.75** L	-19.98**	-61.28** L	9.77**	52.14**	11.52*	85.91**
$P_1 \times P_3$	8.91**	7.11 H	1.64	25.53**	8.11** L	47.65** H	57.65** L
$P_1 \times P_4$	5.21*	-50.99** L	2.41	11.74**	47.53**	22.32**	107.41**
$P_2 \times P_3$	-8.36**	-22.06**	-55.73**	34.27** H	64.37** H	9.36	135.66** H
$P_2 \times P_4$	3.60	-19.01**	13.65 H	13.41**	54.55**	47.61**	106.11**
$P_3 \times P_4$	38.69** H	-26.98**	-19.29**	7.77** L	35.24**	5.75 L	105.29**
L.S.D. $_{0.05}$	0.505	0.450	0.372	0.247	6.225	2.564	0.434
L.S.D. $_{0.01}$	0.683	0.608	0.503	0.334	8.414	3.466	0.587

*,** Significant and highly significant at 0.05 and 0.01 probability levels, respectively.
H= The highest value. L= The lowest value.

Conclusion

The use of dried peels of some squash varieties in processing cake improves its content from and the sensory characteristics. The hybrids obtained from the mating between varieties give high yielding. The amounts of heterosis versus mid-parents showed highly significant values for all studied traits. While, The estimates of heterosis versus the better parent showed highly significance for most studied traits.

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