Sensory characteristics and consumer acceptance of mechanically (canopy contact harvester)-harvested California black olives: Report for 2010-2011

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Materials and Methods

The study examined the sensory properties and consumer acceptability of 10 California black table olives that were produced according to the experimental design shown in Figure 1 below, and harvested either manually or with the canopy contact harvester method of mechanical harvesting. The labels used for the 10 samples throughout the report are shown in Table 1. Our two industrial partners in this project (Musco Family Olives and Bell-Carter) received identical samples that were then processed with two different methods. Thus, 8 treatments, with the olive fruits being harvested either by hand or mechanically [i.e. 2 harvesting methods], then shipped to processor A and B [i.e. 2 processors], and then processed fresh or after being held in storage tanks [i.e. 2 processing methods], and 2 commercial products, one from each processor, were used in the study (Figure 1 and Table 1).

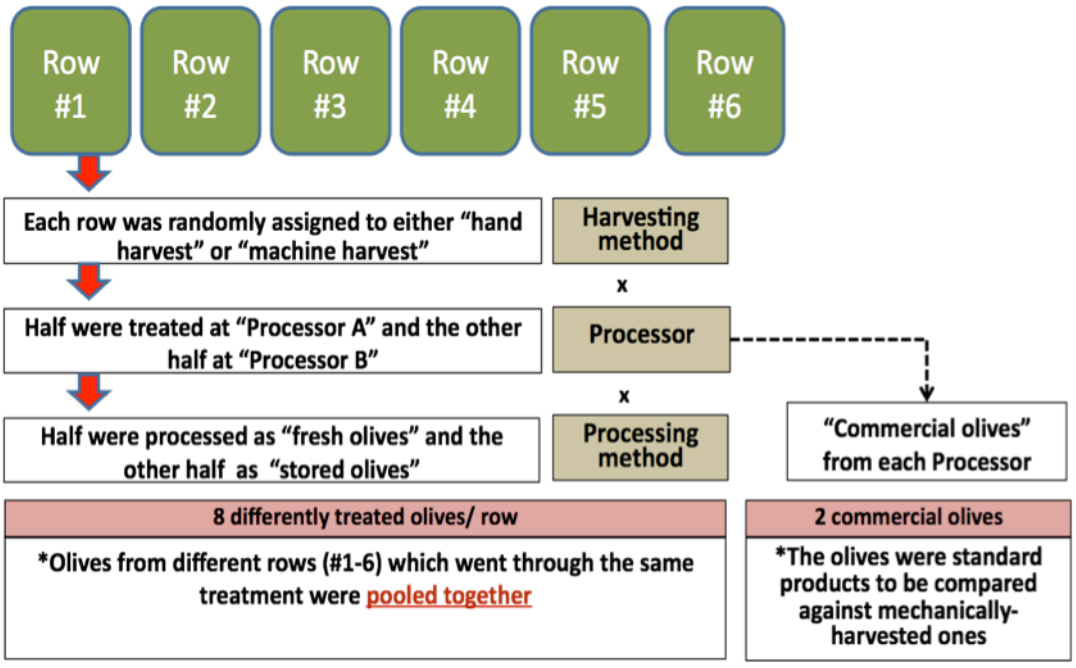


Figure 1 – Experimental design for olive production and harvest

Table 1 – Table olive samples

Sample Abbreviations	Processors	Commercial	Harvesting methods	Processing methods
A_Comm	A	Commercial	-	-
A_Hand_F	A	-	Hand	Fresh olives
A_Hand_S	A	-	Hand	Stored olives
A_Mach_F	A	-	Machine	Fresh olives
A_Mach_S	A	-	Machine	Stored olives
B_Comm	B	Commercial	-	-
B_Hand_F	B	-	Hand	Fresh olives
B_Hand_S	B	-	Hand	Stored olives
B_Mach_F	B	-	Machine	Fresh olives
B_Mach_S	B	-	Machine	Stored olives

Descriptive analysis

The sensory properties of the olives were measured by descriptive analysis with a trained panel of 10 judges (8 female, 2 male), all of them are undergraduate and graduate students at UC Davis.

This year, the panel developed a scorecard with 34 attributes of appearance, flavor (taste and smell), texture, mouthfeel and after-taste (Table 2). After the panel training, all the products were evaluated in triplicate, following a randomized complete block design. Olives were presented at room temperature (20 °C), in a spherical glass covered with a plastic lid (3 whole olives and one sliced in half). The intensity of the attributes was rated on a category line scale labeled with “low” and “high” at the ends of the scale, except for some of the appearance attributes and the lasting flavor which used the labels shown in Table 2 below.

Table 2 – Sensory attributes evaluated in the descriptive analysis

	Attribute	References		Attribute	References
SMELL (AROMA)	Briny/Salty	Olive brine	APPEARANCE	Size	Small --- big
	Ocean-like	Seaweed*		Shape	Round --- Oval
	Sugary/Sweet smell	1) Honey*		Glossy/Shiny	Matte --- Glossy
		2) brown sugar*			
	Fermented/Vinegar	1)Sauerkraut*		Surface roughness	Smooth --- Rough
		2) apple cider vinegar*			
	Sautéed mushroom	Sautéed mushroom*		Degree of discoloration	
	Earthy/Musty	Potting soil*		Skin brownness	(Dark brown color scale)
	Metallic/Canned	Iron tablet solution*		Gradation (Flesh)	Less gradient --- More gradient
	Green/Grassy	Parsley*		Brightness-Grey/Green (Flesh)	(Grey/green color scale)
	Floral	Chrysanthemum*		Brightness-Grey/Brown (Flesh)	(Light brown color scale)
	Painty/Solvent-like	Correction fluid*		Inner roughness	Smooth/soft --- Rough
	Rancid/Oxidized	Rancid olive oil*			
TASTE/FLAVOR	Overall flavor	-	TEXTURE/MOUTHFEEL	Firmness	
	Saltiness	NaCl solution		Crunchiness	
	Umami	MSG + brine		Chewiness	
	Bitterness	Caffeine solution		Juicy/Moisture release	
	Sweetness	Sugar solution		Astringency/Dryness	Steeped green tea
	Buttery*	Melted butter		Mouthcoating	
			Aftertaste	Flavor Lasting	

*mixed with olives

Consumer testing

The olive samples were also evaluated by 109 consumers who were recruited among Picnic Day visitors and Davis Farmer's Market customers. The screening criteria for participation were to be US Residents and black table olives users and liker.

Each consumer was presented with 11 samples, with the first sample serving as a primer, for the purpose of eliminating the first-order effect typically encountered in consumer tests – the first sample receives a higher hedonic score than the subsequent samples in the serving order. The presentation order of the other 10 samples was randomized across consumers. Consumers were instructed to rate overall degree of liking of each sample, followed by degree of liking of appearance, flavor, and texture on the 9-point hedonic scale, from 'dislike extremely' to 'like extremely,' and with 'neither like nor dislike' in the middle. Two whole olives were served in plastic cups covered with lids at room temperature (20 °C). Crackers and water were provided for rinsing and palate cleansing. Upon completion of the tasting, consumers filled an exit survey with demographic, attitude and olive usage information.

Data analysis

The descriptive analysis data was analyzed using a combination of univariate and multivariate statistics. Analysis of variance (ANOVA) was used to examine the effect of each source of variations in the design. Principal component analysis (PCA) was then applied to the matrix of mean intensity ratings across the samples to visually summarize the similarities and differences among the products in the design.

The consumer hedonic ratings were also analyzed using a combination of univariate and multivariate statistics. ANOVA was first performed to observe the effect of each source of variation in the design. The matrix of hedonic ratings of samples across consumers was then analyzed by preference mapping – a combination of factor analysis and classification methods designed to assess preference market segmentation and drivers of liking identification for product optimization purposes. Partial least square (PLS) regression was performed to examine the relation between the hedonic ratings by consumers and the sensory attributes measured by the descriptive analysis panel.

Results and discussion

Descriptive analysis

There were no significant differences between mechanically-and hand-harvested olives for most of the aroma, taste/flavor and texture/mouthfeel attributes. However, the harvesting methods were significantly different in several appearance and after-taste attributes, as listed below (Table 3):

Flavor – Earthy
Taste - Bitterness
Appearance – Size, Surface roughness, Degree of discoloration, Skin brownness and Brightness of grey/green (flesh)
After-taste – flavor lasting

This year's result confirms the result from year of 2008-2009 when canopy contact harvester was also applied that the differences between hand and machine harvested olives mostly lies in appearance and after-taste characteristics. Compared to the year of 2009-2010 when trunk shaker was applied, there were fewer differences in sensory attributes between mechanically-and hand-harvested olives, though the differences in the appearance and after-taste attributes still remain.

There were many significant differences across a range of appearance, flavor, texture, mouthfeel and aftertaste attributes mainly between fresh-processed olives and olives stored before processing (i.e. Processing method); and also, between the 2 commercial olives and the other samples (i.e. commercial vs. non-commercial).

Table 3. F-values for partitioned product source of variation.

	Commercial vs. non-commercial	Harvesting method (hand vs. machine)	Processing method (fresh vs. stored)	Processors (A vs. B)	Harvesting method x Processing method	Harvesting method x Processor	Processor x Processing method
Briny/Salty	**6.38**	0.32	**4.64**	0.14	0.32	0.08	0.61
Ocean-like	**6.91**	1.60	**28.39**	0.23	1.36	0.58	1.27
Sugary/Sweet smell	**37.82**	0.04	**52.28**	0.23	0.52	0.06	**10.38**
Fermented/Vinegar	**39.58**	1.35	**39.78**	0.11	1.24	1.69	**9.91**
Sautéed mushroom	3.72	1.79	**4.73**	1.44	0.13	0.14	**12.88**
Earthy/Musty	**4.28**	0.06	**22.15**	0.00	0.14	**10.51**	3.45

Metallic/Canned	**44.60**	2.58	**76.47**	0.28	1.63	2.17	**17.17**
Green/Grassy	**22.91**	2.49	**68.01**	2.09	1.35	0.82	**4.44**
Floral	**9.27**	0.02	1.64	2.48	2.19	0.13	1.26
Painty/Solvent-like	**35.85**	0.94	74.26	4.81	0.06	1.35	2.69
Rancid/Oxidized	**30.35**	3.10	**30.61**	0.24	0.26	3.10	0.03
Overall flavor	**13.34**	3.66	1.97	1.68	0.14	1.71	1.22
Saltiness	**31.75**	0.00	2.14	0.07	0.46	1.21	**4.32**
Umami	**12.96**	0.06	**36.04**	0.07	0.00	3.57	1.63
Bitterness	**4.64**	2.54	**94.93**	**18.55**	**5.20**	0.93	**11.21**
Sweetness	**12.00**	0.06	**70.46**	0.05	2.66	0.41	0.35
Buttery	**3.90**	1.47	**133.38**	**3.94**	3.23	0.05	1.61
Size	**34.66**	**4.63**	**23.50**	**15.73**	**10.16**	**7.73**	1.86
Shape	**4.37**	0.02	0.10	0.13	0.02	0.87	0.02
Glossy	**7.91**	0.44	0.45	**6.32**	0.18	0.32	0.00
Surface roughness	**25.62**	0.49	3.45	**7.21**	2.69	**4.08**	**17.46**
Degree of discoloration	**34.66**	**4.63**	**23.50**	**15.73**	**10.16**	**7.73**	1.86
Skin brownness	**11.18**	**35.68**	**26.51**	**59.45**	**5.69**	**20.56**	1.53
Gradation (Flesh)	**12.13**	1.93	**5.53**	0.52	1.24	0.13	0.13
Brightness-Grey/Green (Flesh)	**22.91**	2.49	**68.01**	2.09	1.35	0.82	**4.44**
Brightness-Grey/Brown (Flesh)	0.60	**4.26**	**12.61**	2.33	1.33	1.27	**76.31**
Inner roughness	**29.29**	1.30	**37.59**	**3.91**	0.97	0.08	2.88
Firmness	**74.22**	0.19	**6.97**	**6.29**	0.40	0.34	**13.29**
Crunchiness	**72.08**	0.52	3.76	1.80	0.26	0.02	**7.05**
Chewiness	**23.39**	2.30	3.80	**6.09**	0.04	0.58	1.30
Juicy/Moisture release	**22.71**	2.73	**91.11**	**4.17**	0.33	0.09	**7.10**
Astringency/Dryness	1.11	1.11	**26.36**	**18.72**	3.04	1.21	0.27
Mouthcoating	0.38	0.28	**55.18**	3.26	0.42	0.44	2.34
Flavor Lasting	2.09	**4.39**	**7.63**	**4.53**	0.50	2.60	0.16

Bold denotes significant source of variation (P<0.05)

Principal component analysis (PCA) was employed to illustrate the relationships among the sensory attributes and the products in a 2-dimensional sensory map. The principal component (PC) biplot shows the main sensory features of each table olive sample – attributes located close to a given sample tend to be higher for that sample, whereas attributes which are found away from that sample tend to be lower. It also depicts the relationships among the sensory attributes – attributes which are positively correlated tend to form small angles with each other or to be clustered together on the plot, whereas attributes which are negatively correlated are found at opposite ends of the plot.

The biplot of PC1 vs. PC2 is shown in Figure 2 below. PC1 and PC2 explained 75.49% of the variation between products.

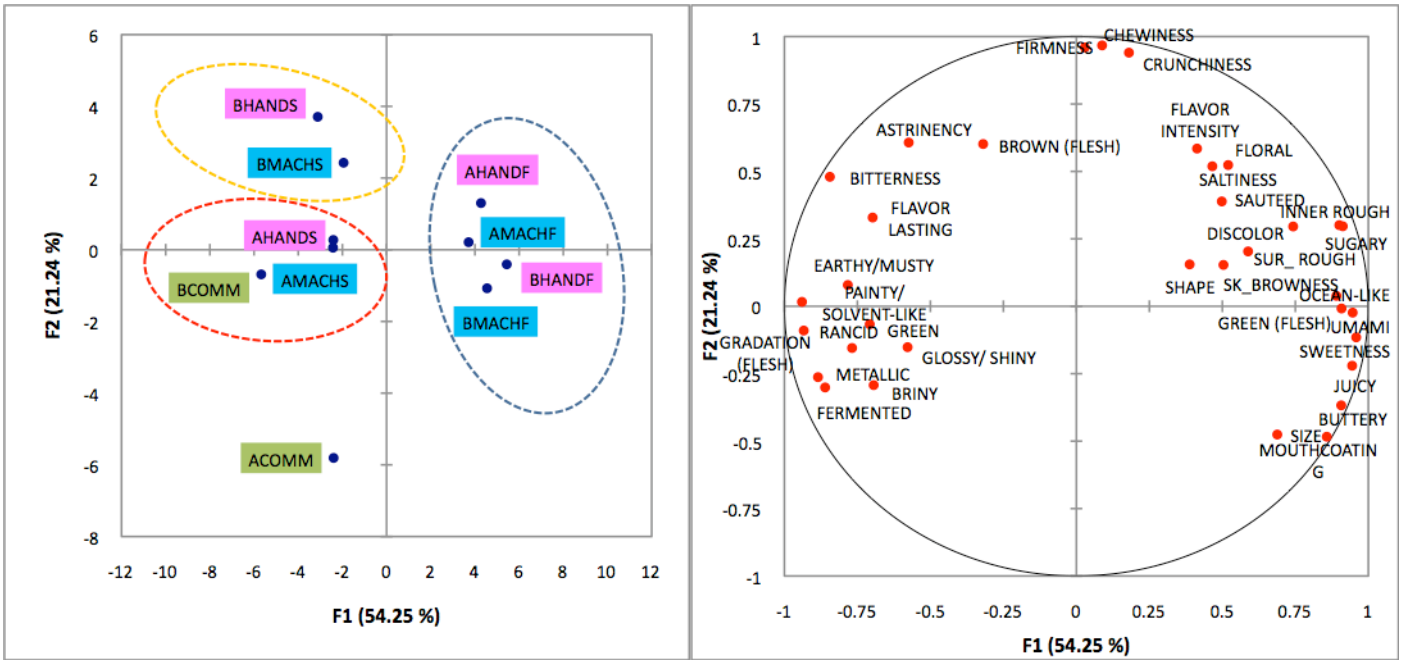


Figure 2 - Principal component analysis of the descriptive analysis data showing the products (left) and sensory attributes (right).

- **The main difference among products was observed between processing method (fresh processed vs. non-fresh (i.e. stored and commercial)), as shown by PC1 (54.25%).** Fresh-processed olives, regardless of harvesting method and processor, were characterized by green flesh, higher skin brownness, surface roughness, ocean-like, sugary, sautéed mushroom aroma, umami, sweet buttery flavor and juicier mouthfeel. Olives held in storage tanks, especially by

processor A were glossy, brighter flesh color, painty, rancid, metallic, briny, fermented, earthy, green aroma, bitter and longer flavor lasting.

- **The next largest difference was observed between commercial from processor A vs. stored olives from processor B, as shown by PC2 (21.24%).** Olives held in storage tanks from processor B were characterized by brown flesh, more astringent, firmer, crunchier, chewier and had higher overall flavor intensity.

- There was no difference between harvesting method. The differences between olives were largely due to processing method.

Consumer test

There was a significant difference in consumer acceptance between processing method (fresh vs. stored). Processing method was the largest source of variation in overall and flavor liking. Commercial vs. non-commercial was a rather important source of variation for texture liking, followed by processing method. Appearance liking was affected by the interaction effects between processor and processing method (Table 4).

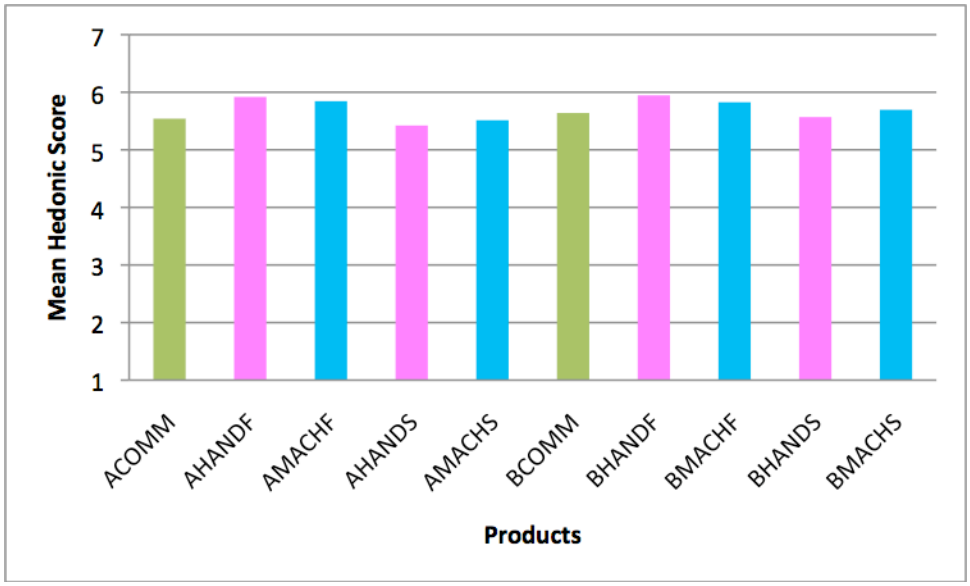
Table 4 – F-values for partitioned product source of variation

	Commercial vs. non-commercial	Harvesting method (hand vs. machine)	Processing method (fresh vs. stored)	Processors (A vs. B)	Harvesting method x Processing method	Harvesting method x Processor	Processor x Processing method
Overall degree of liking	0.75	0.00	**6.52**	0.56	0.62	0.00	0.37
Appearance liking	0.36	0.14	1.43	0.95	2.76	0.01	**6.66**
Flavor liking	0.72	0.07	**8.89**	0.71	0.25	0.27	0.01
Texture/Mouthfeel liking	**12.42**	0.07	**6.21**	1.16	0.13	0.18	2.15

Bold denotes significant source of variation ($P<0.05$).

An examination of the mean hedonic ratings confirms the observations above (Figure 3). The mean hedonic ratings for overall liking indicated fresh-processed olives were preferred over stored-processed olives (Figure 3a). There was no significant difference between mechanically- and hand-harvested olives. The findings were true for flavor and texture liking, but to a lesser extent for appearance liking (Figure 3b). There was a higher degree of appearance liking for stored-processed olives from processor B. In conclusion, the largest source of variation in consumer acceptance was 'processing method.'

(a)



(b)

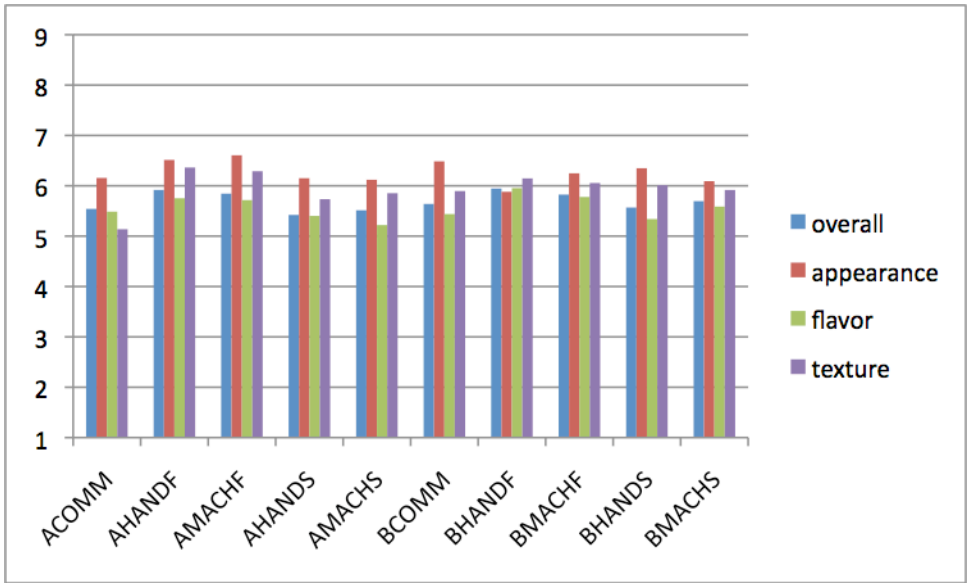


Figure 3 – LS means for hedonic ratings of the 10 olive samples for (a) overall degree of liking and (b) including appearance liking, flavor liking, and texture liking (N=109 consumers)

The overall degree of liking showed the highest correlation to flavor liking, and then to texture liking and appearance liking (Table 5, Figure 4b), similar to what we observed last year. This suggests that flavor characteristics are the most important determinants of consume liking for table olives.

Table 5 – Pearson's correlation coefficients among hedonic ratings by consumers

Variables	Overall degree of liking	Appearance liking	Flavor liking	Texture liking
Overall degree of liking	**1**	**0.596**	**0.914**	**0.734**

*Values in bold are significantly different from 0 with a significance level alpha=0.05

Preference mapping and consumer segmentation

Figure 4 showed the results of the internal preference mapping analysis as bi-plot of the first two principal components; showing the main direction (as vectors) of each individual consumer's preferences for the 10 olives tested (i.e. each dot represents each individual consumer's main preference direction).

The preference map showed that a number of consumers were located on bottom area of the plot, where fresh-processed olive samples were located. The stored-processed olive samples were on the upper area, with those from processor B located on the upper right side while those from processor A located on the left side of the plot. This observation is comparable to the previous year's result (i.e. fresh-processed olives were liked over stored-processed olives). Unlike last year, however, the locations of mechanically- and hand-harvesting methods were placed closely on the plot. This indicated that harvesting method have little influence on consumer acceptance. The preference map also showed differences among the four stored-processed olives, which were due to different processor. This was not the case in last year's research.

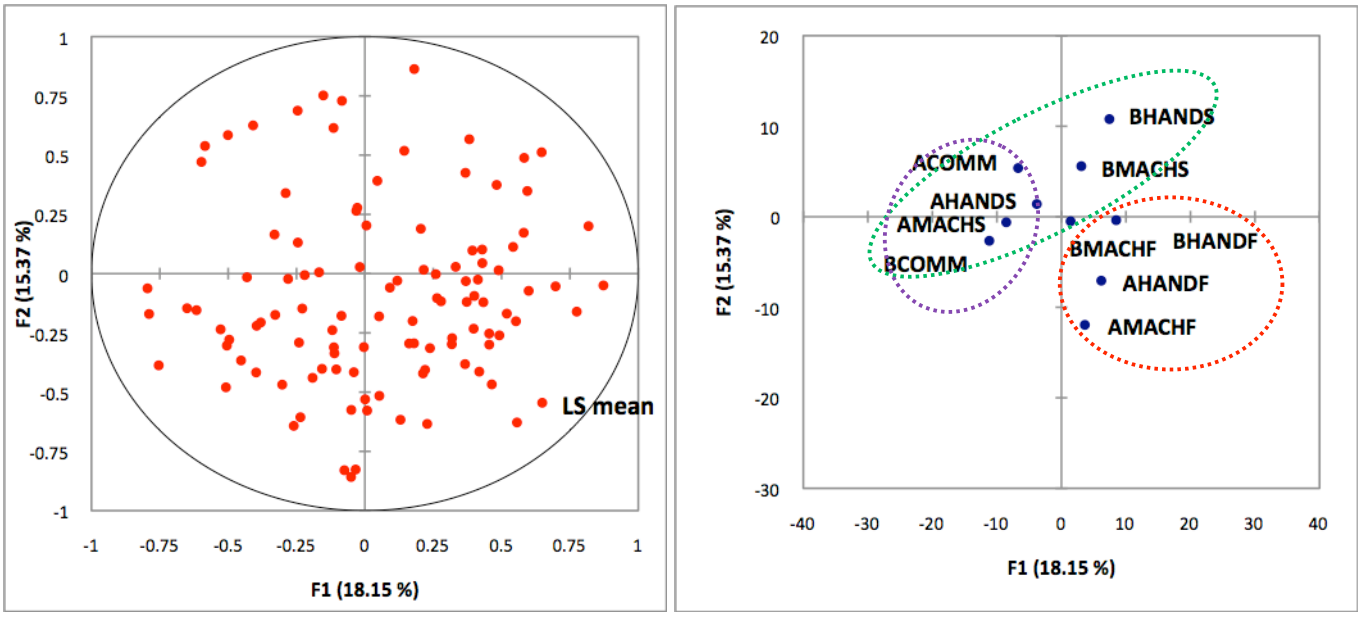


Figure 4 – Internal preference map generated based on overall degree of liking, showing individual consumers and the olive samples (N=109)

Consumer preference for Californian-style black olives could be classified into three possible segments, using cluster analysis (Pearson's dissimilarity proximity matrix; Average-linkage agglomerative method)**.** The consumer segmentation results were shown in Figures 5 and 6 below. Processing method had the most influence on consumer acceptance. The majority of consumers (cluster 2, n=57) preferred fresh-processed olives. The findings, again, indicated that harvesting method did not play an important role in consumer acceptance, while processors influence consumer acceptance to a certain extent. A smaller group of consumers in cluster 1 (n=14) did not displayed a common preference tendency, although preference towards processor A was noticed. Consumers in cluster 3 (n=38) tended towards fresh-processed olives from processor B and commercial products (Figure 7).

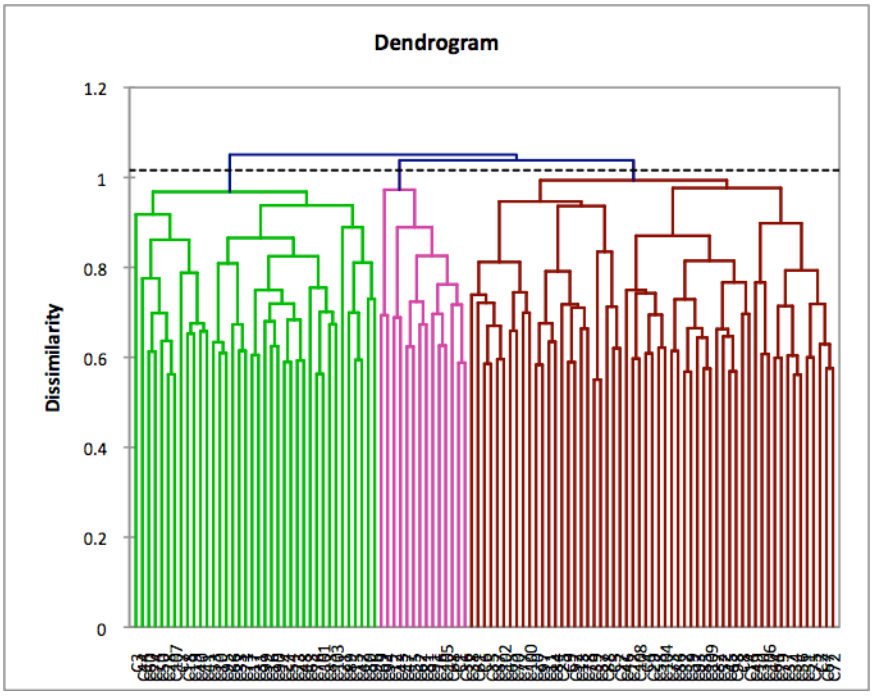


Figure 5 – Cluster analysis dendrogram of the 109 consumers

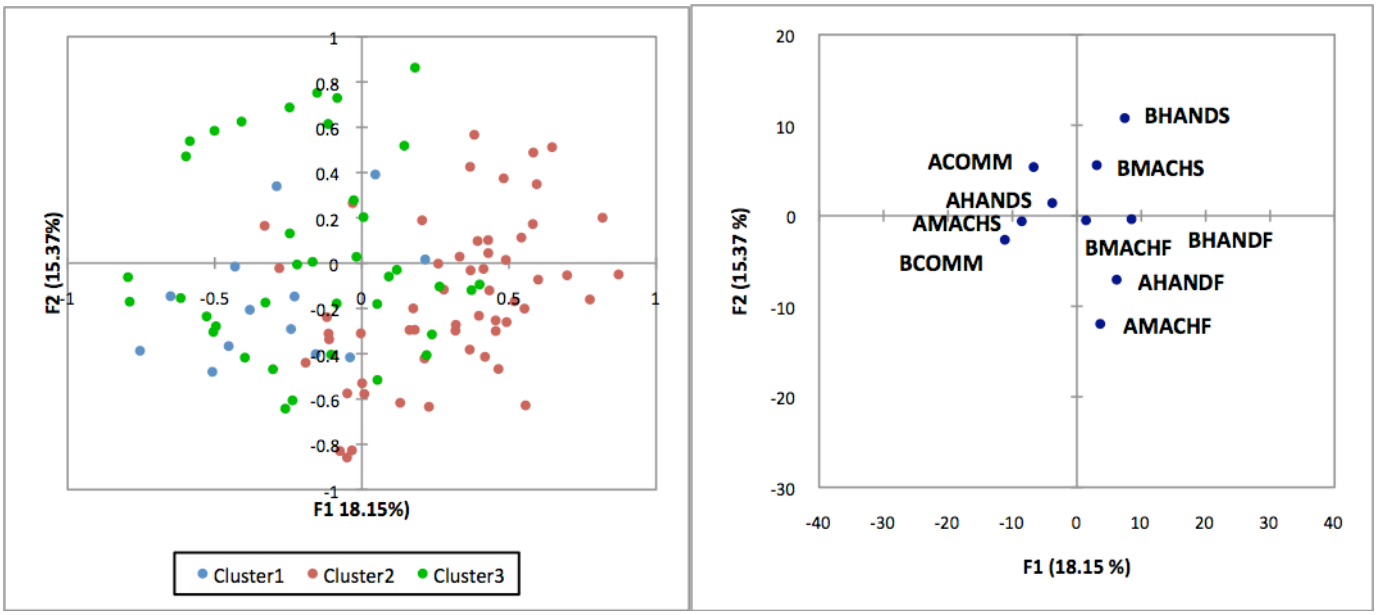


Figure 6 – Internal preference mapping with segmentation

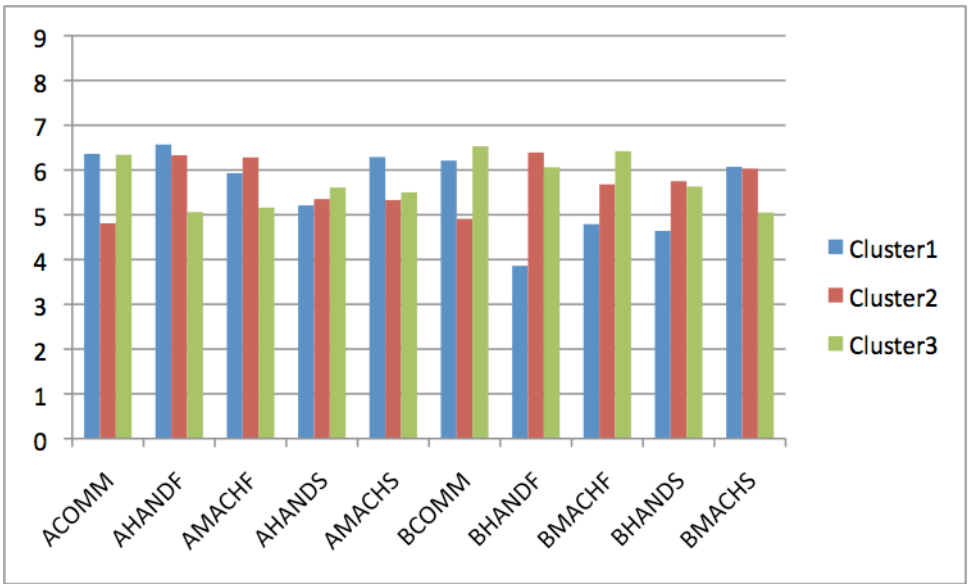
Examination of the interaction between cluster and product indicated that the three clusters were significantly different in overall liking, flavor liking and texture liking, but not appearance liking (Table 6). Mean hedonic scores for overall liking (Figure 7) supports the findings above. Mean scores for appearance liking, flavor liking and texture liking for each cluster were shown in Figure 7.

Table 6 – F-values for differences in liking among consumer clusters

Variables	Overall degree of liking	Appearance liking	Flavor liking	Texture liking
Cluster x product	**5.68**	1.31	**4.49**	**2.59**

Bold denotes significant source of variation (P<0.05)

(a)


9
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Cluster1
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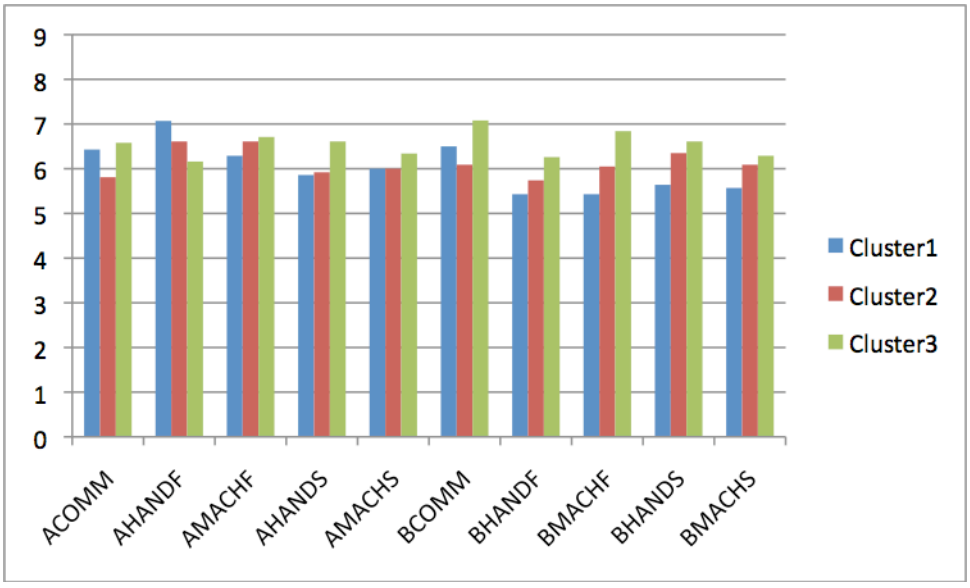
Cluster3

(b)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BCOMM
BHANDF
BMACHF
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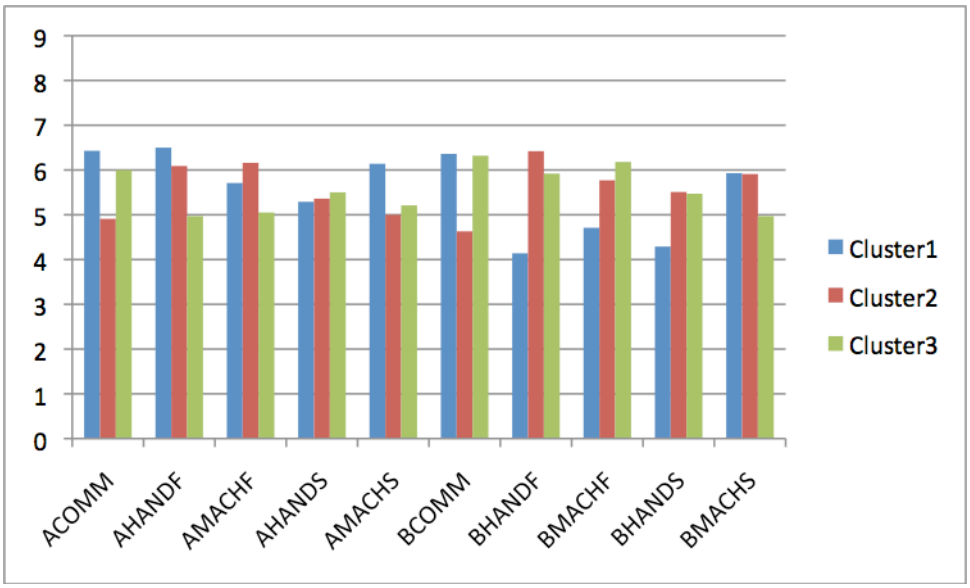
Cluster1
Cluster2
Cluster3

(c)



(d)

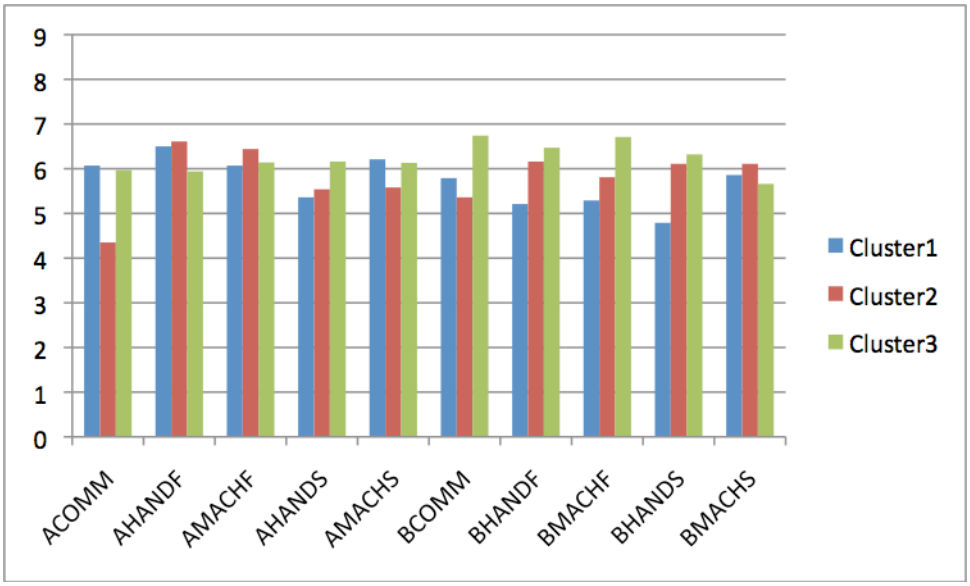


Figure 7 – Mean hedonic scores of 10 olive samples for each cluster, showing (a) overall liking, (b) appearance liking, (c) flavor liking and (d) texture liking.

The overall degree of liking showed the highest correlation to flavor liking, and then to texture liking and appearance liking (Table 7), similar to what we observed in the overall sample. This confirmed that flavor characteristics are the most important determinants of consume liking for table olives.

Table 7 – Pearson's correlation coefficients among hedonic ratings by each cluster

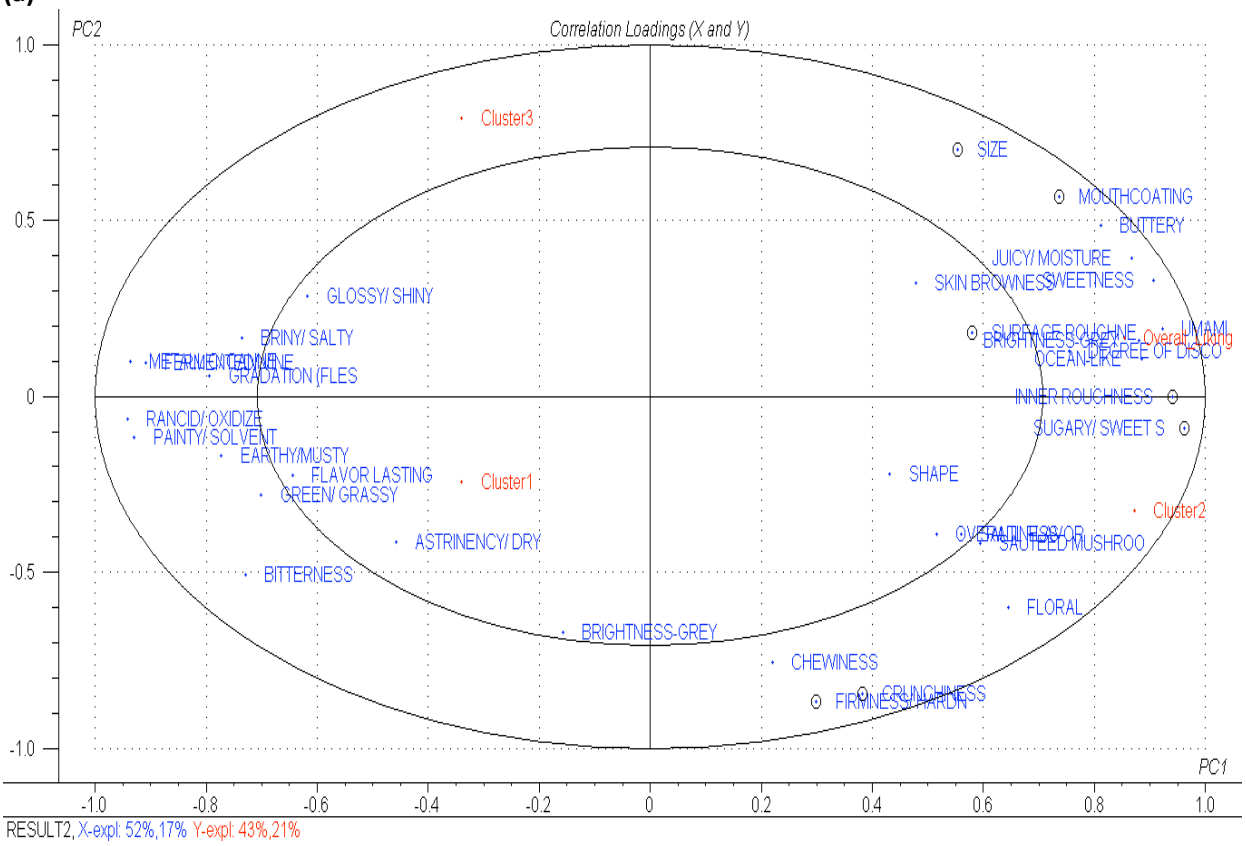
Variables	Overall degree of liking	Appearance liking	Flavor liking	Texture liking
Cluster 1 overall degree of liking	**1**	**0.562**	**0.882**	**0.678**
Cluster 2 overall degree of liking	**1**	**0.556**	**0.905**	**0.778**
Cluster 3 overall degree of liking	**1**	**0.678**	**0.937**	**0.692**

*Values in bold are significantly different from 0 with a significance level alpha=0.05

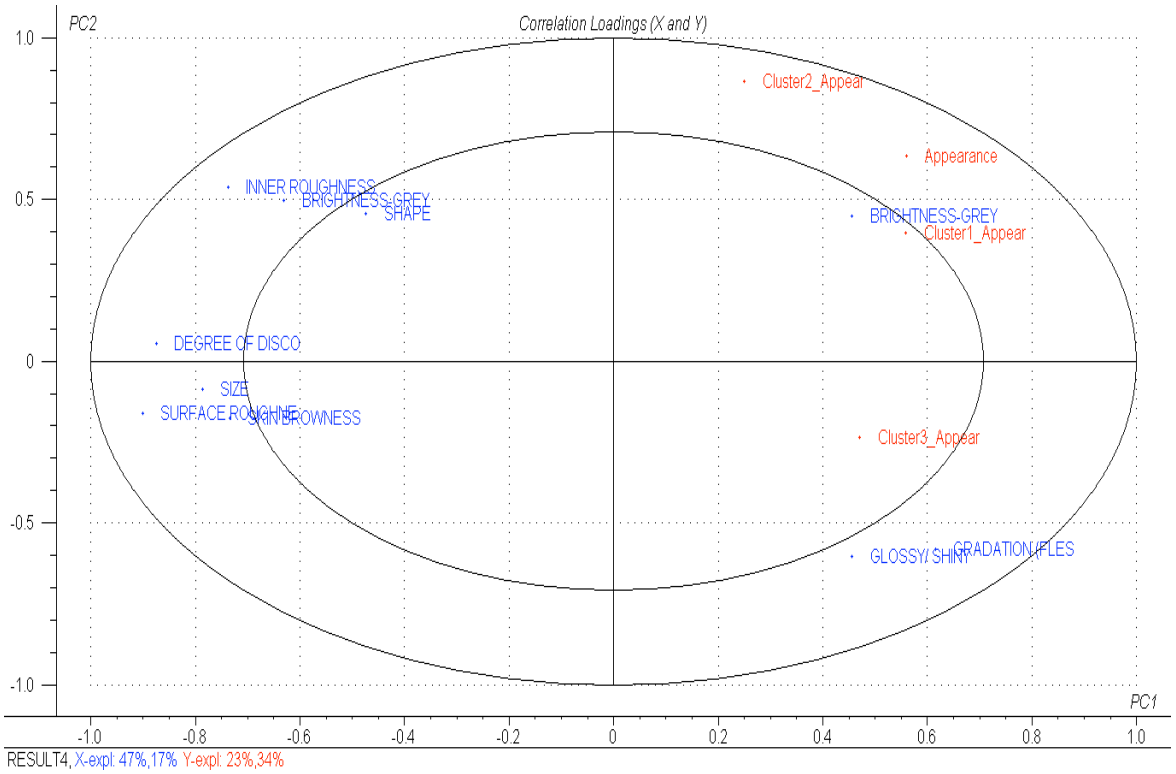
Identification of drivers of liking

PLS-regression was performed in order to examine sensory drivers of consumer liking for black table olives (Figure8). This analysis provides a clearer insight of the black table olives preference characteristic of each consumer segment. The analysis displayed the sensory attributes that were associated with overall degree of liking by each cluster, and more specifically, the appearance attributes that were associated with liking for appearance of olives (Figure 8b), the flavor attributes that were associated with liking of flavor of olives (Figure 8c) and the texture attributes that were associated with liking of texture of olives (Figure 8d).

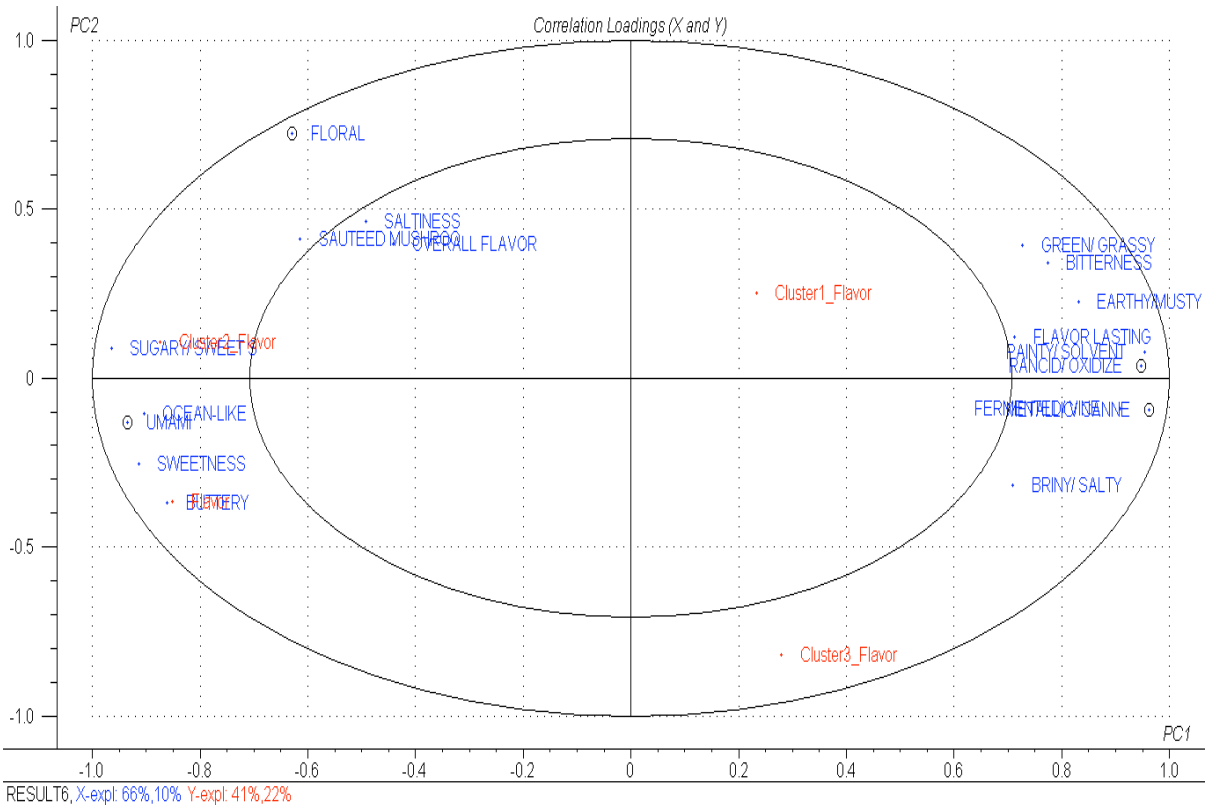
(a)



(b)

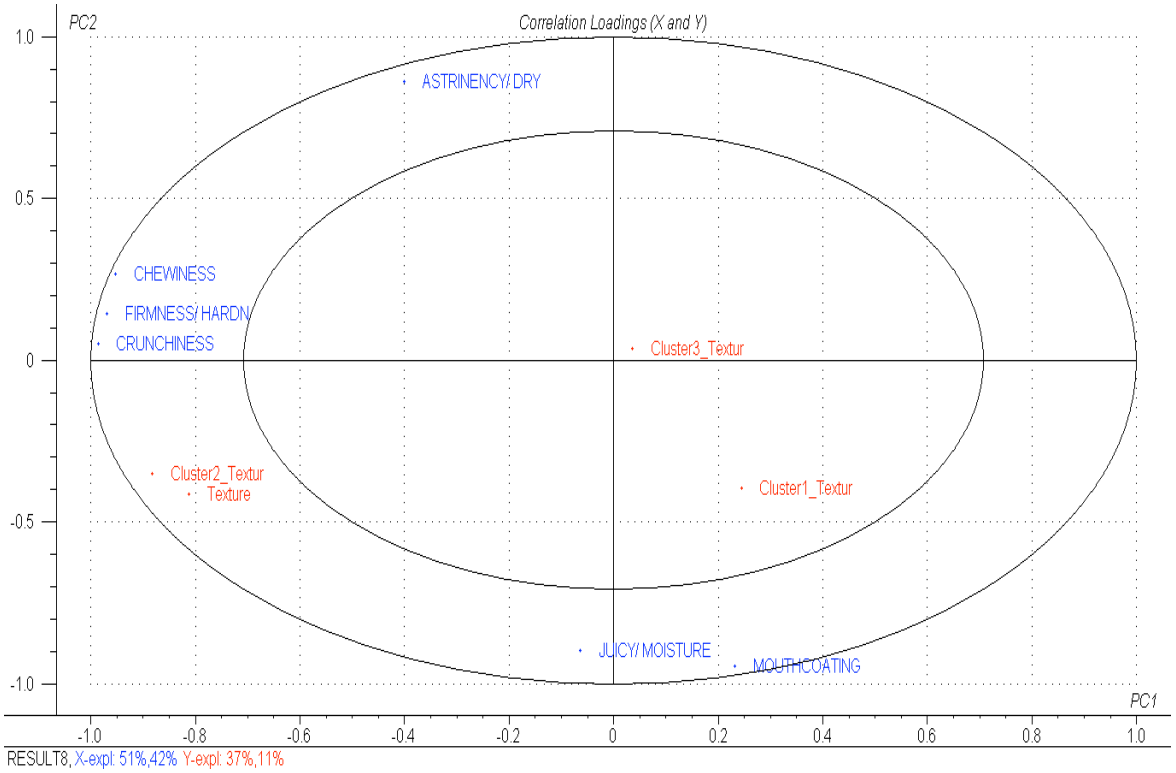

PC2
Correlation Loadings (X and Y)
Cluster2_Appear
Appearance
INNER ROUGHNESS
BRIGHTNESS-GREY
SHAPE
BRIGHTNESS-GREY
Cluster1_Appear
DEGREE OF DISCO
SIZE
SURFACE ROUGHNESS
SKIN BROWNESS
Cluster3_Appear
GLOSSY/ SHINY
GRADATION/FLES
PC1
1.0
0.5
0
-0.5
-1.0
-1.0
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1.0
RESULT4, X-expl: 47%,17% Y-expl: 23%,34%

(c)



RESULT6, X-expl: 66%,10% Y-expl: 41%,22%

(d)



RESULT8, X-expl: 51%,42% Y-expl: 37%,11%

Figure 10 – PLS2-Regression of each cluster hedonic ratings (i.e. a) overall liking, b) appearance liking, c) flavor liking and d) texture liking) onto the sensory attributes from the descriptive analysis

Consumer segment profiles, including demographics and behavioral information are shown in Table 8 and 9.

Table 8 – Demographic profiles of black table olives consumer segments

		Cluster1 (%) (n=14)	**Cluster2** (%) (n=57)	**Cluster3** (%) (n=38)	**Overall** (%) (N=109)
Gender	Male	57.1	40.4	36.8	41.3
	Female	42.9	59.6	63.2	58.7
Age	18-29	42.9	40.4	28.9	36.7
	30-39	21.4	14.0	7.9	12.8
	40-49	28.6	8.8	2.6	9.2
	50-59	7.1	19.3	39.5	24.8
	60-69	0.0	10.5	15.8	11.0
	≥70	0.0	5.3	5.3	4.6
Ethnicity	African/African American	0.0	0.0	2.6	0.9
	Asian/Asian American	21.4	10.5	18.4	14.7
	Caucasion (non-hispanic)	64.3	75.4	57.9	67.9
	Hispanic/Latino	7.1	3.5	7.9	5.5
	Middle Eastern	0.0	0.0	2.6	0.9
	Native American	0.0	0.0	0.0	0.0
	Pacific Islanders	0.0	0.0	0.0	0.0
	Other (specify)	7.1	10.5	10.5	10.1
Marital status	single	35.7	40.4	34.2	37.6
	married	42.9	52.6	60.5	54.1
	divorced/separated	14.3	3.5	0.0	3.7
	widowed	0.0	1.8	2.6	1.8
Number of children under 18 years old	none	71.4	75.4	86.8	78.9
	1	7.1	14.0	10.5	11.9
	2	14.3	5.3	2.6	5.5
	3 or more	7.1	5.3	0.0	3.7
Student		35.7	31.6	15.8	26.6
Occupation	unemployed student	21.4	19.3	10.5	16.5
	retired	0.0	14.0	15.8	12.8
	unemployed	14.3	1.8	7.9	5.5
	employed	64.3	64.9	63.2	64.2
Exercise?	everyday	28.6	15.8	23.7	20.2
	2-3/week	50.0	56.1	47.4	52.3
	once a week	14.3	22.8	13.2	18.3

	once a month	0.0	5.3	7.9	5.5
	never	7.1	0.0	7.9	3.7
Highest education	HS diploma/GED	21.4	21.1	13.2	18.3
	Bachelors Degree	57.1	40.4	44.7	44.0
	Masters	7.1	19.3	15.8	16.5
	Ph.D	14.3	10.5	23.7	15.6
	Professional Degree	0.0	8.8	0.0	4.6
Income	less than $50,000	28.6	33.3	26.3	30.3
	$50,000-$100,000	21.4	21.1	23.7	22.0
	$100,000 +	35.7	35.1	28.9	33.0
	Don't know/prefer no answer	14.3	10.5	18.4	13.8

Table 9– Behavioral information of black table olives consumer segments

		Cluster1 (%) (n=14)	**Cluster2** (%) (n=57)	**Cluster3** (%) (n=38)	**Overall** (%) N=109)
Did you eat olives in…	canape	7.1	24.6	7.9	16.5
	pasta	57.1	63.2	65.8	63.3
	pizza	92.9	86.0	89.5	88.1
	salad	64.3	78.9	78.9	77.1
	sandwich	64.3	38.6	42.1	43.1
	cocktail	21.4	26.3	13.2	21.1
	others (description)	21.4	31.6	18.4	25.7
Did you eat olives by themselves?		71.4	77.2	71.1	74.3
Consumption frequency	≥2-3 times a week	14.3	17.5	15.8	16.5
	once a week	14.3	35.1	26.3	29.4
	once every other week	35.7	21.1	28.9	25.7
	once a month	7.1	14.0	52.6	26.6
	less than once a month	28.6	8.8	26.3	17.4
Often eat olives by themselves	2-3+ times a week	0.0	14.0	5.3	9.2
	once a week	14.3	17.5	7.9	13.8
	once every other week	35.7	14.0	18.4	18.3
	once a month	21.4	19.3	71.1	37.6
	less than once a month	28.6	31.6	94.7	53.2
Do you buy...	black (whole)	57.1	82.5	84.2	79.8
	black (sliced)	35.7	38.6	34.2	36.7
	green (whole)	50.0	66.7	57.9	61.5
	green (sliced)	0.0	14.0	7.9	10.1
	flavored/spiced (black, whole)	35.7	35.1	18.4	29.4

	flavored/spiced (black, sliced)	7.1	5.3	0.0	3.7
	flavored/spiced (green, whole)	50.0	50.9	26.3	42.2
	flavored/spiced (green, sliced)	14.3	7.0	2.6	6.4
	stuffed (black, whole)	7.1	19.3	13.2	15.6
	stuffed (green, whole)	71.4	57.9	50.0	56.9
Source	can/jar	85.7	77.2	78.9	78.9
	deli	57.1	63.2	44.7	56.0
	make my own	7.1	8.8	7.9	8.3
Purchasing frequency	≥2-3 times per week	0.0	3.5	0.0	1.8
	once a week	0.0	10.5	5.3	7.3
	once in every other week	21.4	19.3	15.8	18.3
	once a month	21.4	38.6	47.4	39.4
	once in 3 months	21.4	17.5	10.5	15.6
	less than once in 3 months	28.6	1.8	18.4	11.0
	never	7.1	7.0	2.6	5.5
Factors influencing choice	Type	85.7	89.5	92.1	89.9
	Variety	50.0	64.9	65.8	63.3
	Origin	28.6	35.1	23.7	30.3
	Local	28.6	36.8	44.7	38.5
	Package	28.6	35.1	34.2	33.9
	Nutrition	14.3	12.3	28.9	18.3
	Brand	21.4	24.6	36.8	28.4
	Price	85.7	63.2	71.1	68.8
Responsible for groceries	yes, 100%	42.9	38.6	42.1	40.4
	yes, partially	35.7	54.4	42.1	47.7
	no	21.4	5.3	13.2	10.1
Consider yourself…	conservative	0.0	0.0	2.6	0.9
	somewhat conservative	0.0	10.5	5.3	7.3
	neither	28.6	8.8	15.8	13.8
	somewhat adventurous	28.6	40.4	50.0	42.2
	adventurous	42.9	38.6	26.3	34.9

Conclusion

The main conclusion of this year's research is that there were little differences in sensory quality between mechanically- and hand-harvested olives, which did not significantly influence consumer acceptance.

Compared to last year's research, when we found notable differences between hand- and mechanically harvested olives (but with a trunk-shaking device), this year's results found no significant differences between the two harvesting methods in both sensory qualities and consumer acceptance. The result was in line with the research done in 2008-2009 (with a canopy contact device, similar to the device used this year). Moreover, there were some differences in sensory properties and consumer acceptance of stored-processed olives between the two processors. We were able to identify three consumer segments which differed in preference for black table olives:

- Cluster 1 (n=14): Stored-processed olives
- Cluster 2 (n=57): Fresh-processed olives
- Cluster 3 (n=38): Commercial olives and fresh-processed olives from processor B.

The majority of consumers exhibited preferences for fresh-processed olives, thus fresh-processed olives have strong potential in the Californian-olive market.