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Section A07, Thu 9-11:50 am

Partner: Sh. G

Lab 2.3 (total acidity of different kinds of olive oil)

PURPOSE/OBJECTIVE:

The purpose of this lab is to measure the percent acidity of different olive oils. We are going to titrate 3 different grades of olive oil for their % oleic acid. 3 Types of olive oil that was used for this lab were pure olive oil, extra virgin olive oil and extra light olive oil. An acid base titration can determine the free fatty acid in a sample of olive oil.

INTRODUCTION:

The production of olive oils begins with transforming the olive fruit into olive paste by crushing or pressing. Free fatty acids (FFA) represent the hydrolysis of triglycerides and indicate the quality of oil. The higher amount of FFA in the oil, the lower the quality of oil. Extra virgin olive oil comes from virgin oil (without the use of heat or solvent), and it has a high quality among other olive oils, it contains no more than 0.8% free acidity and it has a great, fruity taste and no defined sensory defects. Extra virgin olive oil is consumed crude so the flavor and polyphenols are conserved. We can determine the oil's acidity which refers to the % of free oleic acid (measuring weight in gram) in it not to its pH. This is a measure of the hydrolysis of the oil's triglycerides.

Consumption of food with the acidity of up to 3.3% for humans is ok but more than that is not fit for humans. Consumers should look in olive oil for acidity levels less than 1%. Extra virgin olive oil has an acidity level of 8% which is the best among all olive oils. Acidity affects the taste and is a determinant of quality. Harvesting and processing methods dictate the ultimate quality. Olive oil is made of primarily 3 types of free fatty acid. It is composed of palmitic, oleic and linoleic. It is mostly composed of oleic acid.

Pure olive oil is another type of olive oils. Pure is just a label for either extra virgin or virgin olive oil and olive oils that are refined. It is used mainly when extracted olive oil is of poor quality and the refining process helps it to have a better flavor.

Extra light olive oil is less pure. They are refined so they may become fit for consumption. This oil is less colorless and tasteless. To make it better for people to buy it, factories may add higher quality olive oil to it to give some color and flavor. Sometimes vegetable oil or canola oil, is added to it as well.

PROCEDURE:

The procedure followed for the experiment is found in "Principles of Food Composition Laboratory Manual" (2013) Experiment 2.3 Total Acidity of Olive Oil, pages 27-36.

DATA/Result:

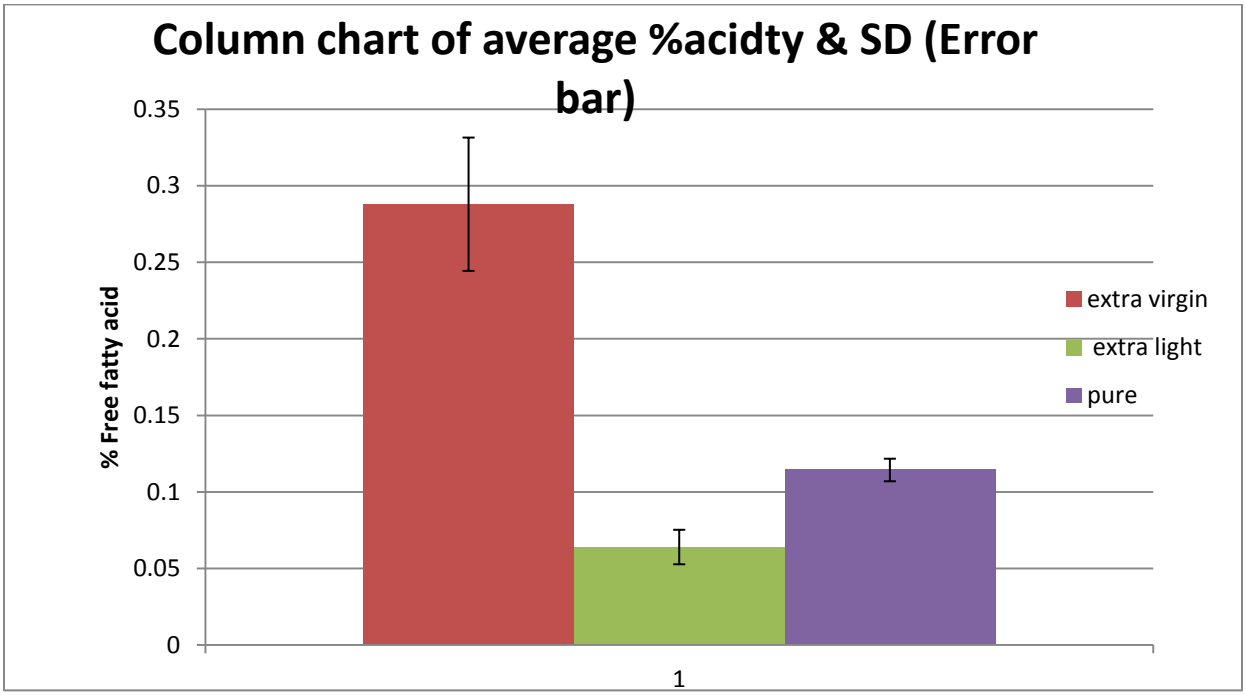
Table 1: Starting volume, ending volume and total volume of NaOH for olive oil titration

Types of oil	Starting volume NaOH (ml)	Ending volume NaOH(ml)	Total volume NaOH(ml)
Extra virgin olive oil	0.00	2.32	2.32
Extra virgin olive oil	2.42	4.51	2.09
Extra virgin olive oil	4.62	6.70	2.08
Extra light	6.82	7.48	0.66
Extra light	7.51	8.00	0.49
Extra light	8.21	8.71	0.50
Pure olive oil	8.97	10.00	1.03
Pure olive oil	10.08	11.00	0.92
Pure olive oil	11.31	12.32	1.01

Table 2: Table of calculated %acidty for each titration, average %acidty & SD for each kind of olive oil

	Extra virgin olive oil	**Extra light**	**pure**
% acidity	0.277	0.077	0.117
% acidity	0.251	0.057	0.106
% acidity	0.336	0.058	0.120
Average % acidity	0.288	0.064	0.114333
Standard deviation	0.043555	0.011269	0.007371

Column chart of average %acidty & SD (Error bar):



ANOVA table of %acidty:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	0.864	0.288	0.001897
Column 2	3	0.192	0.064	0.000127
Column 3	3	0.343	0.114333	5.43E-05

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.08287	2	0.041435	59.80962	0.000109	5.143253
Within Groups	0.004157	6	0.000693			
Total	0.087026	8				

Olive oil tasting sheet:

Rank with regard to deepness of green color: 3>1>2

Rank with regard to deepness of aroma: 3>1>2

Rank with regard to sourness/acidity: 3>1>2

Rank with regard of fruitiness/nuttiness: 3>1>2

Oil #1: pure olive oil

Oil#2: refined

Oil#3: extra virgin

CALCULATIONS:

Total volume NaOH(ml)= Final volume NaOH(ml)- Intial volume Naoh(ml)

Ex: extra virgin:

Start V= 2.42 ml

End V= 4.51 ml

4.51-2.42=2.09 ml

$$\%\text{oleic acidity} = \frac{\text{total volume Naoh(ml)} * (1\text{l}/1000\text{ml}) * 0.117\text{M} * 282\text{g/mol} * 100}{\text{Test portion (g)}}$$

Ex: $$\%\text{ oleic acidity} = \frac{2.32\text{ ml} * 1\text{L}/1000\text{ml} * 0.117\text{M} * 282\text{g/mol} * 100}{27.6\text{ g}}$$

=0.277%

Average acidity:

Ex: % acidity of extra virgin

#1 = 0.277%

#2= 0.251%

#3= 0.336%

AVERAGE %= #1+#2+ #3 /3➔ 0.277+0.251+0.336/3=0.288

Standard deviation:

Ex:

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \overline{x})^2},$$

S=$\sqrt{\frac{1}{0.288-1}}$∑((0.277-0.288)+(0.251-0.288)+(0.336-0.288))^2= 0.43555

DISCUSSION:

Three types of olive oils were tasted in this lab. Extra virgin olive oil had the most fruitiness taste and most green color among the 3 of them; pure olive oil was second and the extra virgin was last. As it was said before extra light can have mix of other oils and that is why it doesn't have the taste and the color of other oils. The percent oleic acid of extra light oil is the lowest and as it was said that the more FFA in oil the lower the quality of that oil. According to this we can say that extra light has the least quality among the 3 oils and extra virgin has the best quality with a less FFA and more oleic acid in it.

3 oils that were tested in this lab are different in quality. Extra virgin is the best because it has the highest average % acidity compare to others. The average % acidity for extra virgin olive oil is 0.288% and pure olive oil is 0.114333% and for extra light olive oil is 0.064%. The more the % oleic acid of the olive oil is the better the quality of the oil. Extra olive oil should has a FFA less or equal to 0.8% to consider extra virgin while US virgin olive oil should be <2%, US refined olive oil should be <0.3% and US olive oil<1.0%. The extra light is good for cooking but it is the lease favorable oil that people buy.

The % of oleic acid in the data section confirms that the extra virgin olive oil contains the most amount of oleic acid which was 0.288%. The pure olive oil has fewer oleic acids than extra virgin, which was 0.114333% and the extra light had the least amount of oleic acid which was 0.064%. .

Different kinds of olive oils were titrated with NaOH and phenolphthalein. The pink color that we got doing each titration was important to get the volume of NaOH that was used to titrate the oil for each part. It was little hard to see the pink color in a green oil.

CONCLUSIONS:

In this lab the percent acidity (% oleic acid) of 3 types of olive oil (pure, extra light, and extra virgin) was determined using the acid base titration method. Free fatty acids are produced enzymatically by lipase which catalyzes the hydrolysis of ester bonds in lipid substrate. There are some factors that contribute to free fatty acid level in olive oil; Microorganism, moisture, temperature, improper storage and careless extraction are some of those factors. These factors affects because they can increase the activity of lipase, the enzyme in the olive fruit. In this lab 3 types of olive oils was tasted and then the same 3 types were used to determine their % oleic acid content. The international olive council and the USDA developed criteria for olive oil quality. In order for an oil to graded as extra virgin olive oil the oil should follow these criteria: a FFA content less than 0.8% and have no sensory defect. Free fatty acid level of different types of olive oil: US extra virgin olive oil <0.8%, US virgin olive oil<2%, US refined olive oil<0.3% and US olive oil<1.0%.

Olive oil some great health benefits such as having essential fatty acid and polyphenol. Polyphenol contribute to the bitter taste, astringency and resistance to oxidation. It is very important for our health that we know what we eat. Eating more than 3.3% acidity from olive oil is bad for our health so with knowing the difference between different types of olive oil and with knowing the % oleic acid of them we can decide what to consume.

Question:

1. Yes, there is difference among the acidity of 3 different types of olive oil.
Extra virgin (0.288) > pure (0.114333)> extra light (0.064).
There are some factors that can have effect on the quality of olive for example careless extraction and process, prolonged with water, fungal disease, delay between harvesting and extraction and insect infestation.

2. No, but It depends. There is not a huge different in the % of oleic acid among different kinds of olive oils. There is a 0.224 difference between extra virgin and extra light olive oil. The difference between extra virgin and pure is 0.173. The average % acidity for extra virgin olive oil is 0.288% and pure olive oil is 0.114333% and for extra light olive oil is 0.064%.

3. The molar mass of oleic acid is 282.4614 g/mol. The more acidic the oil (more oleic acid content) the more NaOH volume (ml) we need to use to finish the titration. The alternative could be that we find % acidity of one of the other five fatty acids like lenoleic(3.5-21% of olive oil), palmatic (7.5-20%), stearic acid (0.5-5) and α-lenolenic acid (0-1.5%).