PHYSICAL AND CHEMICAL ANALYSES OF LOCAL VINEGAR SOLD IN ILOCOS SUR MARKETS

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ABSTRACT

The quality of locally-bottled vinegar sold In the municipal markets of Ilocos Sur was analyzed. Organoleptic testing was used Io determine the quality of their appearance, odor and taste. The percentage composition of the CH,COOH content of each sample was measured and the presence! **absence** of mineral acids in each sample was determined.

AN the vinegar samples (except one) were "Suka Iloko," i.e. these products were prepared by the fermentation of the indigenous sugarcane juice. Santa vinegar sample 1 which became blackish and sourless after several weeks and which had a *very* low CH,COOH content (0.425%) was not only adulterated; it was not prepared by fermentation.

Wgan vinegar samples were likewise found to **be** of low quality. All the three samples were below the standard minimum level.

There were no traces of the presence of mineral acids in all the samples.

INTRODUCTION

Proliferation of adulterated food and food seasonings is becoming a rampant practice in local markets. Inferior or even harmful substances are added to food items like vinegar, lowering their quality and causing harmful effects in body tissues.

"Fake," "adulterated" and "synthetic" are the tenns used by food specialists in describing vinegar which is made simply by mixing glacial acetic acid and water with the addition of colloidal solutions like milk, coconut water or simply water to make it appear cloudy. (Manila Bulletin, February 4, 1988). This vinegar-like mixture is sold at prices, 20% to 30% cheaper than the naturally fennented vinegar. (Manila Bulletin, June 25, 1988).

Even naturally-fermented vinegar may contain significant levels of pollutants or toxic substances like copper, lead, mercwy or arsenic, which maybe derived from the use of inappropriate vessels in the fermentation process.

Vinegar may also be contaminated with sul tides, when the fruits or vegetables used as materials are sprayed with chemicals. Some reckless producers and merchants even add H,SO, to make it more sour. This contaminated vinegar like formalin-preserved fishes and napthalene-contaminated Thai rice, endangers the health consumers.

Suka Iloko

Ilocos Sur is well known for its "Suka Iloko." It is vinegar prepared from the sugarcane juice. The juice called "bennal" is placed in earthen jars and allowed to feanent for 3-4 months usually with the aid of the tannin-rich bark sarnac (Macaranga tamarius Linn). The popular Ilocano fermented wine called "basi" is product of the alcoholic fermentation of "bennal" which is eventually made into suka Iloko through acetous fermentation.

$$C_{12}H_{22}O_{11} \text{ ----> } C_6H_{12}O_6 \text{ ----> } 2C_2H_5OH \text{ ----> } CH_3COOH$$

Suka Iloko is not spared from the current adulteration of food and food seasoning by local dealers. Coconut water or simply potable water is added to increase its volume. It is even feared *that* glacial CH,COOH is being used by some unscrupulous Ilocano merchants, without considering the harmful effects it brings to the consumers. This is precisely the main reason in undertaking this study.

OBJECTIVES OF THE STUDY

This study attempted to detennine the physical and chemical qualities of locally-bottled vinegar sold in the markets of selected municipalities in the province of Ilocos Sur. These municipalities are Cabugao, Candon, Magsingal, Narvacan, Santa, Santa Cruz, San Juan, Santa Lucia, Santa Maria, Santo Domingo, Sinait, Tagudin and Vigan.

The physical properties of the samples were measured in terms of appearance, taste and odor of the samples.

The chemical properties were based on the percentage of the CH,COOH content of the sample and the presence/absence of mineral acids.

RESEARCH DESIGN

FIG. I. Shows the experimental paradigm that was followed through the course of the study.

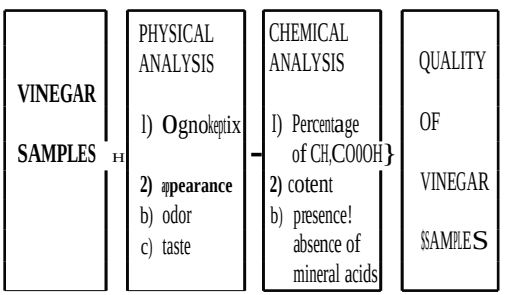

FIGURE 1

Experimental Paradigm in the Physical and Chemical Analyses of Local Vinegar Samples

Taste, odor and appearance of the vinegar samples were the indicators of the physical quality of the vinegar samples. The chemical quality was determined from the concentration of the CH,COOH in each sample and the presence/absence of mineral acids, particularly H_2SO_4.

Three samples were collected from each municipality and three replications were made for each sample.

METHODOLOGY

The descriptive method of investigation was used in the physical analysis of the vinegar samples. The appearance, odor and taste of the samples were evaluated by selected faculty and students. Mass of samples was determined for the computation of the percentage of CH,COOH for each sample.

Experimental method was applied in determining the percentage composition of CH,COOH in each of the samples. The samples were titrated with 0.5 N - NaOH standard solution. The percentage of CH,COOH was then computed, using the following formula:

$$\% \text{ CH,COOH} = \frac{\text{NVNaOH) x CH,COOH}}{\text{Mass of Sample}} \times \frac{1000}{} \times 100$$

The chemical reagent used in the mineral acid determination was ethanol with methyl orange as indicator.

REVIEW OF RELATED LITERATURE

Genuine vinegar is the product of incomplete oxidation of ethanol to acetic acid produced by primary fermentation of vegetable materials,

cereal grains or fruit juices. Any plant organ with rich carbohydrate content, which can be fermented to ethanol can be used as raw material in making vinegar. These substances however should be made to undergo the process of fennentation. This process is a series of chemical reactions, by the catalytic action of living organisms on the organic materials. In the preparation of vinegar, these so-called living organisms are vinegar bacteria belonging to genus Acetobacter or Acetomonas, which are contained in the "mother of vinegar" (Spurgin, Queensland Journal, Agri Science, 1964).'

The standard procedure for vinegar-making is set by the Department of Health as contained in Administrative Order Nos. 134, s. 1970, to wit:

> Vinegar is the liquid produced by the alcoholic and acetous fennentation of one of the following raw materials: malt, spirit wine, cider, alcoholic liquors, fruit grains, vegetables, glucose, sugar or molasses.

Reports on the appropriate CH,COOH content of vinegar are quite diversed. Milagros Ramos, Head of Microbiological Research Division of DOST stated that vinegar should contain not less than *3.5* grams of CH,COOH per 100 ml of solution and should be prepared by fermentation. If the concentration is less than *3.5%,* there is a great possibility for the growth of harmful microorganisms in the vinegar solution. (Interview, 1989).

Sears and Staniski (1970) described vinegar as containing from 3.5–4.0 grams CH,COOH per 100 ml of solution with the distinctive flavor and aroma of the natural materials (fruit juices, cereal grains) originally used, which are retained or modified during fermentation. Cable (1960) cited vinegar as containing from 4%- 6% CH,COOH. Hence in this study, the optimum level for CH,COOH content in the vinegar sample is from *3.5%-* 6%.

The Food and Drug Administration Bureau, which was created by virtue of Rep. Act 3720 supervises and monitors the safety and purity foods, drugs and cosmectics being made available to the public. Section 1406 of this Act states that a food should be deemed adulterated if any substance has been added or mixed with it increase its bulk or weight or to induce its quality or strength or to make it appear better. (Pharmacy Law, UST Press, 1952).

Glacial CH,COOH contains not less than 99% CH,COOH. It may also contain a little amount of sulfurous acid or sulfuric acid depending on the method used in the preparation. It has a pungent, sharp and irritating odor and when diluted with H,O, it has penetrating acid taste.

For mineral acid test in the vinegar samples, the pH of the sample falls to 1.3 if mineral acid is contained in the sample. The pH of typical vinegar ranges from 2.5 to 3.5. At pH 1.3 methyl orange indicator turns to reddish color. (Seminar Paper, PACT, April 27, 1989).

DISCUSSION OF FINDINGS

The physical and chemical qualities of three vinegar samples. collected from each municipality are discussed in the subsequent sections.

Cabugao Vinegar Samples

The three vinegar samples taken from different vendors in the municipal market of Cabugao, were perceived to be satisfactory in physical quality. Samples 1 and 3 were rated as very satisfactory in appearance.

Sample I contained CH,COOH which within the standard percentage content (3.5% 6%) but samples 2 and 3 were a little below minimum accepted percentage.

These three samples were "suka lloko" made from sugar cane juice as evidenced by odor and appearance of the samples. Organic molecules present in the samples may had been

Table 1. Summary of the Physical and Chemical Test Results of Cabugao Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	VS	S	S	4.58	
2	S	S	S	3.17	
3	VS	S	S	3.00	

Legend:

VS = very satisfactory
S = satisfactory
US = unsatisfactory
negative (mineral acids (H,SO, e.g.) are not contained in the sample.

derived from the bark of the samac tree which usually used as fermenting agent in the production of suka Iloko. The samples did not contain mineral acids.

Candon Vinegar Samples

Among the vinegar samples taken from the local market of Candon, sample 3 was rated as unsatisfactory in taste, due to its very sharp, unpleasant sour taste. It was however rated as satisfactory in odor and appearance. The two other samples were found to be satisfactory in appearance, odor and taste.

Vinegar sample 1 had the highest percentage of CH,COOH (5.49%), followed by sample 3 (4.66%). Sample 2 was below the minimum accepted CH,COOH level, an indication of adulteration.

All the samples showed negative reaction to mineral acid test.

Magsingal Vinegar Samples

All the Magsingal vinegar samples were considered as "suka Iloko". Sample 1 was "very satisfactory" in appearance, due to *its* clear, reddish color. This sample was also perceived as "satisfactory" in odor and taste. The two other samples were also "satisfactory" in appearance, odor and taste.

Sample 3 was 0.2% lower than the 3.5% standard minimum level for CH,COOH **while** sample 2 showed a concentration of 4.06%.

All the samples reacted negatively to mineral acid test.

Table 2. Summary of the Physical and Chemical Test Results of Candon Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	5.49	
2	S	S	S	3.26	
3	S	S	US	4.66	

Table 3. Summary of the Physical and Chemical Test Results of Magsingal Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	VS	S	S	*5.44*	
2	S	S	S	4.06	
3	S	S	S	3.30	

Narvacan *Vinegar Samples*

The three samples taken from Narvacan local market were described as "satisfactory" in physical quality, and derived from sugarcane juice. The CH,COOH content of each sample was within the standard accepted level. Sample 3 exhibited the highest percentage of CH,COOH (5.49%) among the three samples.

Reaction of the samples in the mineral acid test was negative.

Santa *Vinegar Samples*

Santa vinegar sample 1 was rated as "satisfactory" in appearance, odor and taste, but after long standing the appearance and taste changed, from brownish red *to* black with a sourless taste. This indicated *that* this sample was "fake" vinegar. Further evidence of adulteration was the very low percentage of CH,COOH (0.04%). However, there was no indication of the presence of mineral acids. Among all the samples taker from the thirteen municipalities of Ilocos Sur, Santa vinegar sample I was ranked the lowest both physical and chemical properties. It was "suka Iloko".

In contrast with sample 1, sample 2 described as "very satisfactory" in odor and taste, with 5.71% CH,COOH content.

Table 4. Summary of the Physical and Chemical Test Results of Narvacan Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	4.54	
2	S	S	S	4.57	
3	S	S	S	5.49	

Sample 3 was also rated "very satisfactory" in taste and satisfactory in appearance and odor. Its CH,COOH concentration was within the standard level (4.34%). There were no indications of the presence of mineral acids in the three Santa vinegar samples.

Santa Cruz Vinegar Samples

A "very satisfactory" rating was given Santa Cruz vinegar sample 3 in odor, due to pleasant, sour odor and the aroma of sugarcane wine. The other samples were rated "satisfac-

Table *S*. Summary of the Physical and Chemical Test Results of Santa Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	0.425	
2	S	VS	VS	5.71	
3	S	S	VS	4.34	

tory" in appearance, odor and taste. All the three samples were suka Iluko.

Sample 2 yielded the highest percentage of CH,COOH (3.71%) from among the 3 samples.

For mineral acid test, the methyl orange indicator did not undergo color transfonnation.

San Juan Vinegar Samples

San Juan vinegar sample I was described as a clear reddish brown solution with a pleasing sour taste and hence was given **a** "very satisfactory" rating in appearance and taste and "satisfactory" in odor. The two other samples were likewise perceived as "satisfactory" in physical qualities.

Sample 1 yielded the highest percentage of CH,COOH among the 3 samples (3.96%). Samples 2 and 3 did not meet the minimum accepted CH,COOH level for typical vinegar.

San Juan vinegar samples were fermented vinegar from saccharine solutions but physical and chemical tests indicated that a significant

Table 6. Summary of the Physical and Chemical Test Results of Santa Cruz Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	3.68	
2	S	S	S	3.71	
3	S	VS	S	3.28	

Table 7. Summary of the Physical and Chemical Test Results of San Juan Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	VS	S	VS	3.96	
2	S	S	S	3.05	
3	S	S	S	2.72	

Table 8. Summary of the Physical and Chemical Test Results of Santa Lucia Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	3.32	
2	S	S	S	5.24	
3	S	VS	S	2.72	

Table 9. Summary of the Physical and Chemical Test Results of Santa Maria Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	S	5.00	
2	S	S	S	2.83	
3	S	S	S	5.40	

volume of water was added particularly to sample 3 for the purpose of increasing the volume of the solution.

The three samples reacted negatively to mineral acid test.

Santa Lucia Vinegar Samples

Santa Lucia vinegar sample 3 was rated as "very satisfactory" in odor. It was considered one of the best among the entire samples collected in the 13 selected municipalities. The two other Santa Lucia samples were rated as physically satisfactory.

Sample 3 had a high percentage of CH,COOH (5.40%) followed by sample 2 (5.24%). The CH,COOH content of sample 1 (3.32%) was below the minimum acid level of typical vinegar and although considered as derived from sugar cane, addition of significant volume of water was evident.

There were no indications of the presence of mineral acids among the three samples.

Santa Maria Vinegar Samples

All the three vinegar samples taken from Santa Maria local market were rated "satisfactory" in physical qualities.

Sample 2 yielded a low percentage CH,COOH (2.83%) as compared to samples 1 and 3 (5.00% and 5.40%). Although the three samples had aromatic saccharine odor and taste, the low CH,COOH concentration of sample 2 was an indication of adulteration.

Santo Domingo Vinegar Samples

The clear, translucent reddish-brown appearance of Santo Domingo vinegar sample accounted for its "very satisfactory" appearance and "satisfactory" odor and taste. The two other samples were likewise rated as physically satisfactory. These samples were "suka Iluko".

Sample 3 however did not meet the minimum 3.5% level of CH,COOH content. In contrast, sample 2 yielded a high **percentage** of CH,COOH (5.71%). Sample 1 also contained a high CH,COOH content (4.14%).

Mineral acids were negligible in these 3 samples.

Sinait Vinegar Samples

All the three Sinait vinegar samples were found to have a pleasant sour taste, with traces of saccharine flavor and hence given "very satisfactory" ratings.

Samples 1 and 2 yielded CH,COOH content which was within the borderline of the optimum accepted level (3.47% and 3.50%). Sample 3 contained 5.03% CH,COOH.

The samples were not adulterated with mineral acids.

'Table 10. Summary of the Physical and Chemical Test Results of Santo Domingo Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
I	VS	S	S	4.14	
2	S	S	S	5.71	
3	S	S	S	3.39	

Table 11. Summary of the Physical and Chemical Test Results of Sinait Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
I	S	S	VS	3.47	
2	S	S	VS	5.03	
3	S	VS	VS	3.50	

Table 12. Summary of the Physical and Chemical Test Results of Tagudin Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
I	VS	S	S	5.58	
2	VS	S	S	3.49	
3	S	S	S	6.15	

Tagudin Vinegar Samples

Tagudin vinegar samples 1 and 2 were rated ..very satisfactory" in appearance due to their clear translucent reddish brown color with a saccharine-acidic aroma and flavor. The physical properties of sample 3 were "satisfactory". It yielded the highest concentration of CH,COOH (6.15%) among all the samples collected in the 13 municipalities of the province. It exhibited a strong acid odor and taste. Sample 1 was also noted to contain a high percentage of the acid (5.58%). However, sample 2 contained only 3.49% CH,COOH. All the samples were "suka Iluko."

either with water, coconut milk or rice washings. No traces of mineral acids were evident, however in these samples.

CONCLUSIONS

The local markets in the municipalities Ilocos Sur generally sell "suka lluko", **a native** vinegar of high quality, *that* is prepared from juice of the indigenous sugarcane plant.

A vendor from Santa local market, however, sells "fake" vinegar, which bas undergone the fennentation process. (Santa vinegar sample 1).

Table 13. Summary of the Physical and Chemical Test Results of Vigan Vinegar Samples

Sample No.	Physical Tests			Chemical Tests	
	Appearance	Odor	Taste	%CH,COOH	Mineral Acid Content
1	S	S	US	2.25	
2	US	S	S	2.53	
3	S	S	S	2.20	

These samples reacted negatively to mineral acid test.

Vigan Vinegar Samples

There were indications of adulteration in vinegar samples taken from Vigan market. Sample 2 was rated "unsatisfactory" in appearance and sample I was given "unsatisfactory" taste. Sample I bad an irritating acidic flavor but its CH,COOH content was only 2.25%.

Sample 2bada milky appearance lacking the **flavor and** aroma of saccharine juice. Its CH,COOH content was also very low (2.53%). Sample 3 bad similar properties with the two other samples.

If these samples were derived from fermented saccharine juice, they **were** adulterated

There are also indications of adulteration other vinegar samples like Candon sample 2, San Juan sample 3, Santa Lucia sample 1 and Santa Maria sample 2.

Proliferation of adulterated vinegar in Vigan market, the capital town of llocos Sur is very evident.

RECOMMENDATIONS

1. The public should be informed or minded of the penalty imposed in the adulteration and selling of adulterated food, specifically, vinegar. Local vinegar consumers and dealers should be made aware of the health hazards, that fake seasoning causes. The Food and Drug Authorities should conduct a regular

surveillance on the sale of adulterated vinegar in the local market.

2. Housewives should be trained to prepare their vinegar supply by the utilization, not only of sugarcane juice but of other indigenous materials. Scientific techniques of alcoholic and acetous fermentation should be taught to them through seminar-workshops and demonstrations. Their risk of using fake vinegar will be eliminated and they can save a certain amount of their market budget, by not buying their vinegar needs. Eventually, enterprising housewives may expand their vinegar production and establish a cottage industry, producing and selling their vinegar products.

3. Further researches should be undertaken on the following:

a. Determination of toxic ions in local vinegar samples.
b. Microbiological assay of vinegar samples
c. Use of indigenous leaves and barks as fennenting agents in vinegar preparation.

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