DEVELOPMENT AND CHARACTERIZATION OF VEGETABLE HEALTH DRINK FROM RED SWEET POTATO LEAVES, SQUASH AND CARROTS

by
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ABSTRACT

An attempt to prepare a Vitamin A-rich vegetable drink was done on Red Sweet Potato Leaves (*Ipomea batata*), Carrots (*Daucus carota*), and Squash (*Cucurbita maxima*) with calamansi syrup as the acidulant to all the three preparations. The preliminary findings show that the carrot, squash and red sweet otato leaves (RSPL) preparations contain 49 mcg. 18.5 mcg. and 15 mcg. B-Carotene respectively. It also showed that in nutrient loss, the general trend was less in tin cans. During the six-month storage time, the B-Carotene loss was highest in RSPL in both the glass jars and tin cans.

A ready-to-drink (RTD) preparation with a ratio of one (1) part of the concentrate with two (2) parts water for RSPL and Squash and with three (3) parts water for Carrot was preferred. Comparing the three preparations, the RSPL was most acceptable.

INTRODUCTION

To maintain life and enjoy good health is a complicated activity. The human body, a non-stop grinding machine, need nutrients from food for growth. And according to Fang and Wu (1986) the body needs nutrients to repair body tissue (protein), to regulate physiological processes (minerals and vitamins) and to generate energy (calorie-rich foods) for all life's function. Vegetables can be good sources of minerals and vitamins that are very essential to human life. It also provides the large amount of dietary fibers which is a needed cure to the so-called "rich-man's disease". And to have the correct quality and quantity of the daily body requirement aside from money, it needs correct attitude as well as self-discipline.

In the Philippines today, malnutrition is not uncommon. This state of nutritional deficiency is being observed in rural areas as well as in the slums of Metro Manila. Malnutrition

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however is not a monopoly of the poor but also of the affluent. This is often due to the lack of correct information and awareness of the proper food to eat.

Dr. Wah Wong, the then UNICEF Resident Representative to the Philippines and South Pacific reported that about 100,000 children suffers from Vitamin A deficiency annually in developing countries (BT-November 27, 1978) and 20,000 (FAO/UN) of these children become blind each year in this part of the world, the Philippines included. At the "Ospital ng Maynila", this is observed where children are suffering from poor eyesight to total blindness.

Vitamin A, the eye vitamin, was discovered in 1913 by four scientists (McCollum, Davis, Osborne and Mendel) and in 1933, Karren and his associates established the chemical nature as consisting of C20H27CH20H. Vitamin A is fat soluble and is affected by light. Its main function is to maintain the visual purple of the eye, which gives the ability to adopt to changes in light intensities especially in dark situations. The daily requirement has been established to be of small quantity with 4,000 IU or 2.4 milligram of B-carotene as sufficient to satisfy the daily needs of the body.

It has been observed according to several authors that Vitamin A deficiency, when it occurs in early childhood (0-4 years), has irreversible effects. The deficiency aggravates the dryness and lusterless condition of the eyeball (Xerophthalmia). It also leads to night blindness and to total blindness at its severest stage. This condition can be remedied however, if recognized and diagnosed at an early stage and where intensified Vitamin A diet is immediately supplemented.

This study hopes to contribute to the solution of the creeping darkness in the world of the very young. Even in the Pre-Historic times, many Vitamin A-rich vegetables have been used by the Chinese for the cure of night-blindness and many other eye disease. J.S. Chen (1986), states that the consumption of ready-to-serve drinks are becoming important in the Republic of China and they have two purposes for the manufacture of juices: 1) for preparing a pleasant-tasting "soft" drink and 2) as a source of Vitamin A and C in the diet.

In the Philippines today, the most immediate need would be to develop a Vitamin A-rich drink that is pleasant tasting as well as affordable by the low-income families who are the most af-

fected. As a developing country, the utilization of local materials would give every economic advantage to our would-be consumers. Local vegetables of high B-carotene content (See Table 3) such as carrots, squash and red sweet potato leaves (RSPL) were chosen as raw materials in this study, as they are easily cultivated all over the Philippines. They can be made available at any season from your own backyard. The vitamin A content of these vegetables however are present as B-carotene but are converted into Vitamin A in the body. These vegetable preparations can also be a source of other nutrients such ass Phosphorus which is good for bone formation. And when properly prepared, these drinks can be healthful for growing children.

MATERIALS AND METHODS

The best state of the vegetables to be processed should be farm fresh, and fully developed for carrots and squash to get a high soluble solid vegetable juice. For the sweet potato tops, the most important criteria for selecting is its freshness and intensity of the redness of the tops and stems as well as the other leaves attached to a twelve-inch stem span.

For all the three vegetables, the common steps done were acidulation with calamansi syrup of the concentrate, sensory evaluation, chemical analysis and bottling. Processing/pasteurization was also done on all samples in one-half (½) pint bottles and cans at a tempt of 85 to 90 degrees celcius. These were then labelled and set aside for shelf-life and storage quality determination.

Some portion of the concentrates were packed in plastic bags with thickness of 0.1 mm, sealed, labelled and also set aside for observations and considerations for other packaging purposes.

Using the 9-point Hedonic Scale Preference Test, the sensory evaluation was done by a panel of twelve (12) people on the freshly prepared concentrates and compared with commercial brand ready-to-drink mixes. The RSPL drink was compared with Strawberry Cold Mix powder, while the Squash and Carrot juices were compared to Orange (Tang) powder. The results were statistically analyzed for significant differences.

Samples for chemical analysis were taken from the fresh as well as from the 6 mos. old preparations for protein, total solids,

total sugar, total acidity (citric/ascorbic acid), B-carotene and some minerals (Ca and P). The standard procedure for the analysis was taken from the Association of Official Analytical Chemists (AOAC), 1975.

In addition to the chemical analysis, a microbiological examination was also done to detect any growth of harmful bacteria or molds on the six-month old samples.

In all the preparations, stainless steel utensils were used to produce a quality juice.

Preparation of the Vegetable Concentrates

a. Red Sweet Potato Leaf (RSPL) Concentrate

The red-stemmed sweet potato leaf was chosen for its exotic value - the development of a cherry-red color of the water extract upon the addition of calamansi syrup that makes it appealing. We may call it RSPL Cola if treated with carbon dioxide.

The raw materials used in the preliminary preparations were procured from the market without varietal identity. However, UPL-Sp-1 variety was provided us for our subsequent trials by the Root Crop Section of the Research Division, of the Bureau of Plant Industry.

It is the freshness of the leaves that has priority in the decision for selection. In all the trials, the leafy vegetables were always weighed and the average recovery of its tops and other red-stemmed leaves was 20% for those bought from the market, while 47% of edible leaves was recovered from the UPL-Sp-1 sample. It was observed that the redness of UPL-Sp-1 was more on the tops with an increasing green leaves toward the mature end, hence, the extract was light pink while the market sample gave a dark pink concentrate.

The fresh sweet potato leaves were washed, and weighed after destemming. The liquid used to make the RSPL extract was four (4) cups of water for every 200 grams of clean and destemmed RSP leaves. The water was boiled and when boiling was at its fullest, the leaves were added, the casserole covered and boiling allowed to continue for 4-5 minutes. The decoction was strained while hot and allowed to cool for 20 minutes or just above room temperature (about 35 deg. centigrade) before ½ cup of calamansi syrup was added to every cup of water extract (See item C for

calamansi syrup preparation). The boiled leaves was still a potential source of food nutrients when used as green salad. Table 3 shows the nutritive content of the raw and boiled leaves (FCT, 1980).

The calamansi treated extract is now called the basic concentrate from where the ready-to-drink mix were prepared. The concentrates are bottled in any desired containers that can withstand heat and pasteurized for 15-25 minutes depending upon the size - for half pint, 15 minutes; for one pint, 20 minutes; and for one liter, 25 minutes. These were then labelled and set aside for shelf-life observation and subsequent analysis. The freshly prepared concentrates were subjected to sensory evaluation, comparing them to a commercial brand, the Strawberry Cold Mix which was so chosen because its color approximates the color of the RSPL extract. The RTD was prepared by adding two (2) cups of water for every cup of the RSPL concentrate. As for the Strawberry Cold Mix, 20 grams powder was dissolved in every cup of cold water. Then a panel of 12 were asked to evaluate the acceptability of the leaf concentrate against the commercial brand. The result was then analyzed for any significant difference.

b. Squash and Carrot Concentrates

Fresh, fully developed and mature squash and carrot were chosen for this purpose. The dark color and smoothness of skin are an added criteria for both vegetables.

The squash was washed and thinly peeled and deseeded before it was sliced to about one cm cube sizes. The recovery was 75%. Water added to cook the vegetable was four (4) cups for every kilo of raw materials. These were allowed to boil for 10 minutes or until tender.

The cooked squash was pureed, with the aid of an electric osterizer to produce a homogenous product. Other household methods can also be used, a stone grinder or plain wood or stainless steel laddle to mash the vegetable. Then ½ cup of calamansi syrup was added to every cup of the homogenized squash. The mixture was then bottled in clear or amber-colored glass containers. Tin cans were also used.

The ready-to-drink mixture was prepared by adding two (2) cups water to every cup of the freshly prepared vegetable concen-

trates, then chilled before comparison to a commercial brand product. The Tang Orange powder which was chosen for both Squash and Carrot was due to its color and orangy taste.

The Tang Orange ready-to-drink as control was prepared by dissolving in a cup of cold water twenty two (22) grams of the powder. It was also chilled before a panel of twelve (12) judges were asked to taste both the control and squash juice.

As for the carrot concentrate, the smooth-skinned vegetable with a dark orange color was chosen. The carrot was washed, trimmed and peeled thinly getting an 80% recovery. This was boiled as in Squash, using the same proportion of water (4 cups) for every kilo of the clean and peeled carrots. The cooking time observed was also ten (10) minutes or until tender.

To produce a homogenous liquid sample, the cooked carrot was osterized and for every cup of liquid carrot, ½ cup of calamansi syrup was added. The mixture is the basic concentrate. It was mixed well then bottled and processed for fifteen (15) minutes in half-pint bottles.

The freshly prepared carrot concentrate was diluted to three times its volume. This is the ready-to-drink (RTD) juice submitted for preference test. A panel of twelve people were invited to assess its acceptability against the Tang Orange prepared the same way as in Squash.

c. Calamansi Syrup

Medium size calamansi were washed and hand pressed to extract the juice. To every 100 pieces, an average of two (2) cups pure juice was collected. One and three-fourth (1 3/4) cups of refined sugar was added to every cup of the calamansi juice to make the syrup/nip. In this paper, this is referred to as calamansi. It is suggested that the sugar be well dissolved and no air bubbles are present before using, to more or less assure an accurate measurement and obtain the correct proportion for both the concentrate and the calamansi.

It was conceived that no chemical additives (artificial food flavors, enhancers and colors) be added since the target users are children and the low-income families who may not have enough information on the dangers of excessive use of additives. Chemical colors or flavors when not properly used may cause some harm on the physical health of a person. The concentrates were as natural

as possible and are patterned after Group 2 of Pederson's Classification of Juices, e.g. a juice material with an acidulant. Here, calamansi was the acidifying agent. Figure 1 and 2 shows a schematic diagram on how the concentrates were prepared.

RESULTS AND DISCUSSIONS

I. The effect of sugar, acidity and color on its acceptability

General factors such as eye-appeal, sweetness and acidity were considered in the characterization of the vegetable drinks. The vegetables were diluted to different ratios. Higher ratings were given to the following proportions with general acceptability shown in Table 1.

UPL-Sp-1	-	1 cup concentrate to 2 cups water
Squash	-	1 cup concentrate to 2 cups water
Carrot	-	1 cup concentrate to 3 cups water

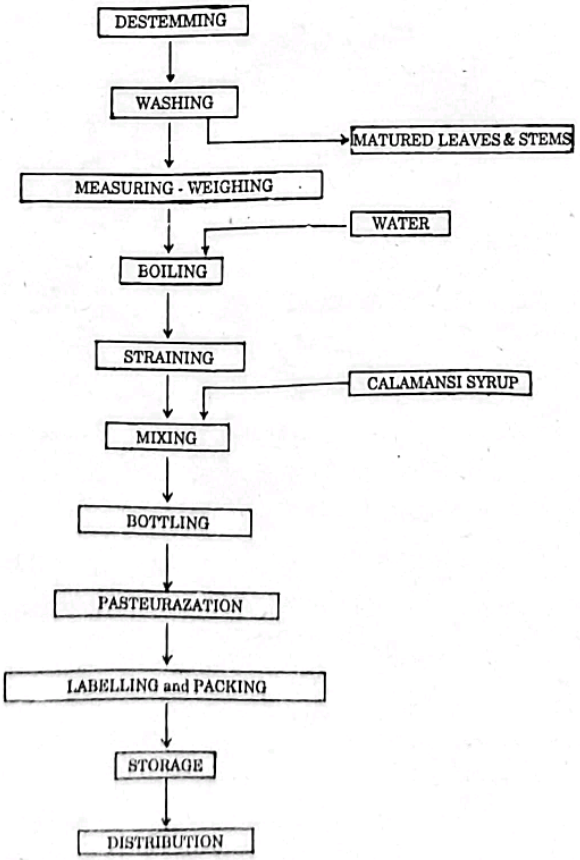

Fig. 1. Red sweet potato leaf concentrate flowsheet.

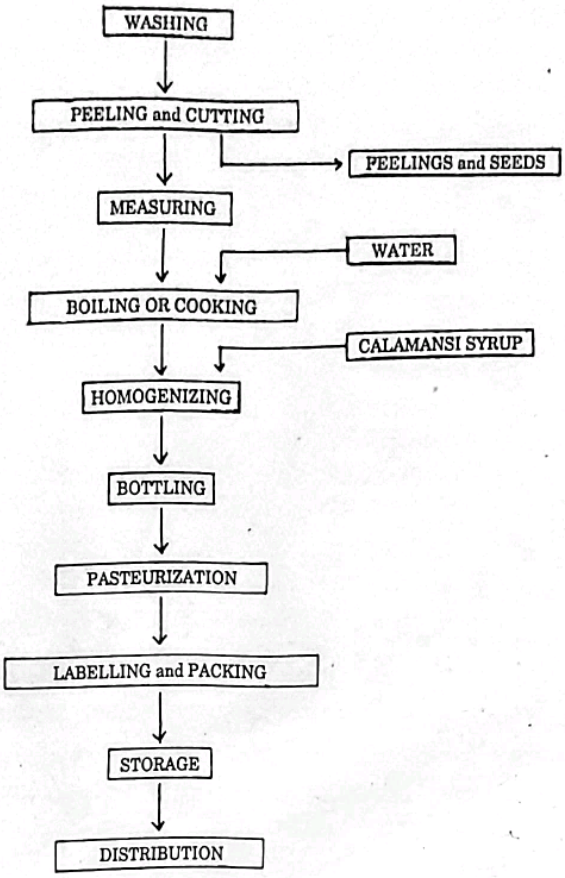

Fig. 2. Carrot and squash concentrate flowsheet.

The sugar content (7%) and the color of the RSPL juice prepared from the samples bought in the market are among the factors that give a high score (6.7) it got among the juices. With the individual comparison of the RSPL juice to the Strawberry Ready Mix, the UPL-Sp-1 scored a low 5.3 rating which incidentally was also the general acceptability score of the commercial brand, as rated by the twel-member-panel. The favorable result of the comparison for Carrot (5.92) against the Orange Tang (5.6) was observed. The same trend was seen with the Squash (5.72) against the Tang Orange (5.6). This is an indication that the vegetable health preparations can be made acceptable to the greater populace.

II. The Effects of Different Containers on the Shelf-Life of the Products

The samples in plastic bags observed at room temperature were discarded after four days. They were vulnerable to house

Table 1. Comparative characterization of the vegetable health preparation against the commercial brand ready to mix drinks.

PRODUCT	TOTAL SUGAR CONC.	RTD*	pH CONC.	RTD*	COLOR DESCRIPTION CONC.	RTD*	GENERAL ACCEPTABILITY RTD*
Carrot with Calamansi	29	8	3.02	3.20	Bright Orange	Bright Orange	5.92
Squash with Calamansi	29	11	2.92	3.09	Bright Yellow	Light Yellow	5.72
Red Sweet Potato Leaves With Calamansi (Market)	32	7	2.86	2.64	Dark Pink (Cherry Red)	Dark Pink	6.7
Red Sweet Potato Leaves With Calamansi (UPL-Sp-1)	27	9	2.52	2.68	Light Pink	Light Pink	5.3
Strawberry (Cold Mix)	—	8	—	3.11	—	Dark Pink (Almost Violet)	5.3
Orange (Tang)	—	9	—	2.95	—	Dark Yellow Orange	5.6

*Ready to drink

pests, such as cockroaches, ants and bugs. However, the concentrates in plastic bags kept at 0-20 degrees Celcius had a longer shelf-life. The plastic had its advantage in frozen state or where space is limited in a cold storage.

The samples in glass jars and tin cans were subjected to the same chemical analysis as the freshly prepared juices. The nutrients showed some changes, either it decreased or increased as can be seen in Table 2 during the six-month period. The ascorbic acid or vitamin C, a water soluble vitamin and easily affected by heat was very unstable and decreased considerably. It played a dual role, however in these concentrate. It served as a source of vitamin C requirement of the body (30 mg/day) as well as an antioxidant for its B-Carotene content, since vitamin C can not be synthesized by the body, it is essential to incorporate this nutrient in our food intake. According to Dr. J. B. Jaime of the Food and Nutrition Research Institute, the life of Vit. C in the body is between 60-120 hours only. The same author stated that B-carotene (pro-vitamin A) is stable at a certain state but does not exist in itself. It occurs in combination with carbohydrates and proteins. It is fat soluble and can be stored in the liver as Vitamin A for as long as 365 days. This vitamin is not only affected by light but by heat and air as well (Micropedia, 1974).

A. Clear Glass Jars

The sweet potato leaves decreased its B-Carotene by 40% while the vitamin C by 67%. The protein remained almost constant while the total solids decreased by 28%.

The carrot concentrate also decreased its B-Carotene, Vit. C and total solids by 33%, 42% and 6%, respectively.

The Squash concentrate kept in clear glass jars also decreased its B-Carotene and Vit. C contents by 31% and 58% respectively. The total solids on the other hand increased by 10%.

B. Tin Cans

Generally, the trend of decrease in tin cans was less compared to clear glass jars on its total solids and B-Carotene while on Vitamin C, the decrease was the same on the sweet potato and squash concentrates. The total solids and B-Carotene contents of the squash concentrate increased by 5% and 4% respectively. The Vitamin C content of carrots decreased by 50%.

Table 2. Comparative analysis* of the acidulated vegetable concentrate.

CHEMICAL CONSTITUENT PRESENT IN %	CARROT			SQUASH			RED SWEET POTATO LEAF		
	FRESH	6 MONTHS GJ**	TC***	FRESH	6 MONTHS GJ**	TC***	FRESH	6 MONTHS GJ**	TC***
MOISTURE	70.25	72.25	71.11	70.45	67.53	69.24	71.20	79.72	75.90
PROTEIN	0.57	0.58	0.59	1.09	1.08	1.08	2.16	2.15	2.15
TOTAL SOLID	29.75	27.75	28.88	29.55	32.47	30.76	28.69	20.37	24.10
VITAMIN A	4.90	3.25	3.37	1.85	1.43	1.93	1.50	0.89	0.91
VITAMIN C	9.04	4.69	3.75	9.04	3.75	3.75	5.80	1.88	1.88
P_2O_5	25.38	25.37	25.16	20.90	21.10	21.44	15.87	15.20	14.71
C_9O	0.04	0.05	0.06	0.05	0.04	0.05	0.06	0.05	0.05

*Analysis done at the Agricultural Chemistry Section, LSD, BPI
**Clear Glass Jar
***Tin Can

C. General observation on both containers

The total solids of the fresh and the six-month old concentrates were all above the standard which is 25%. The microbiological examination showed that there were no harmful microorganisms present, however, the concentrates of carrots in glass jars and the squash in tin cans were found positive for some viable microorganism but negative for coliform colonies and mold and yeast counts.

III. Comparison of the Vegetable Concentrate to Commercial Brands

As can be seen in Table 3, the result of the comparison shows a very promising future for the concentrates. The rating of RSPL from UPL-Sp-1 variety which was 5.3 was the same with that of the Strawberry Cold Mix (5.3) while the RSPL bought from the market was 6.7 showing a significant difference at 5%.

The carrot (5.92) also showed significant difference with Tang Orange (5.6) while Squash (5.75) when compared to Tang Orange (5.6) was higher although not very significantly different. The fact that the rating were all above 5 (acceptable) is an indication that there is good prospect for all the concentrates. The RSPL concentrate had the advantage of having the natural color due to the anthocyanin pigment present in all its cellsaps that turns dark pink upon addition of the calamansi syrup. The color of Carrot was also significantly above the Tang Orange ready mix.

Table 3. Composition of raw and boiled Red Sweet Potato Leaves, Carrot and Squash*

VEGETABLES	E.P.	MOISTURE	FOOD ENERGY	PROTEIN	FAT	TOTAL CARBOHYDRATES	FIBER	ASH	CALCIUM	PHOSPHOROUS	IRON	B-CAROTENE EQUIVALENT	THIAMINE	RIBOFLAVIN	NIACIN	ASCORBIC ACID
	%	%	Cal.	Gm.	Gm.	Gm.	Gm.	Gm.	Mg.	Mg.	Mg.	Mg.	Mg.	Mg.	Mg.	Mg.
Red Sweet Potato Leaves																
Raw	59	81.8	57	4.7	0.6	11.3	3.9	1.6	105	74	4.3	3,890	0.11	0.20	1.0	36
Boiled	38	93.6	18	3.4	0.6	0.8	4.8	1.6	112	74	4.3	2,720	0.06	0.18	1.0	14
Carrot																
Raw	82	86.7	48	1.5	0.4	10.5	1.1	0.9	69	38	2.1	10,290	0.04	0.04	0.8	8
Boiled	82	89.2	39	1.1	0.4	8.6	1.1	0.7	60	33	1.9	10,115	0.03	0.03	0.5	6
Squash																
Raw	71	88.7	38	1.4	0.5	8.6	1.0	0.8	61	40	0.7	880	0.06	0.05	0.8	20
Boiled	71	82.2	40	0.8	0.4	9.8	1.2	0.8	72	38	0.6	740	0.05	0.04	0.9	16

*Source – Food Composition Table – FNRI – 1980

CONCLUSION

Carrots, Squash and sweet potato leaves are potential sources of Vitamin A. On the standpoint of nutrient value, Carrots and RSPL give more advantage if consumed when freshly prepared. The Squash concentrate however proved more stable. Its B-Carotene contents especially when stored in tin cans instead of decreasing, increased slightly. This may be due to the presence of protein and some amount of carbohydrates that contributed to its stability as B-carotene, since it occurs in combination with these components in nature.

The concentrates, even without additives when compared to a commercial brand, show good promise of wide acceptability especially when coupled with a campaign for its nutritional advantage. Despite the non-addition of any chemical preservative and artificial colors, the concentrates were more than acceptable by all the judges. The inherent colors of the three vegetables were quite stable and qualifies to the natural food category which is very healthful. There is a demand for natural food, and is rapidly becoming a fad among dieters and health-food-concious group of people.

As for the most appropriate package for the concentrates, the half pint bottle, white/amber are considered most ideal especially if there are no refrigerators in the homes of the consumers. For large consumers (hotels/restaurants), a one liter/gallon bottle would be practical and economical. As much as possible, locally available containers should be used to avoid high cost of production and at the same time help our local industry.

Other vitamin A-rich vegetables such as other green leafy crops can be possible materials for the purpose of preparing a healthful drink especially in the rural areas where fresh vegetables can be made easily available. People from far flung areas can be educated as to the food value of these indigenous crops. The important help it can give to the maintenance of good health in our daily struggle for life and to the solution of the prevalent eye deficiency problem in our country will go a long way in the prevention of this disease in any part of the country. The adoption then of these drinks in the family will bring to our doorstep an

easy cure to eye disease. The utilization of these vegetables have a multiplying plus effect to the farmers gain, to the savings of the family, and to the health of the nation.

RECOMMENDATION

From among the three (3) vegetables that had been processed into drinks, the Red Sweet Potato Leaf (RSPL) Concentrate scored a highly significant general acceptability. The vegetable concentrate was significantly different in color and has a highly significant difference in flavor when compared to a commercial cold mix brand.

The other advantage of the RSPL over the other vegetable is its easy availability in all parts of the country since any household can cultivate this crop in the backyard. It can also be easily prepared as a beverage for the whole family without any sophisticated gadgets. This could be a source of an instant, cheap and nutritious drink by just boiling for 3-4 minutes about 100 pieces of leaves or tops in four (4) cups of water. To this strained decoction squeeze 8 pieces of medium sized calamansi. The consumer may add a sweetener either white/brown sugar or honey as the case maybe according to the preference of the user. The resulting drink costs about P0.68/glass when all of the materials are bought, or spend only P0.15/glass if the RSPL and calamansi is from the backyard garden.

All these plus factors for this commodity is in addition to the dual advantage that this crop offers. First, we get a nutritious beverage after boiling the leaves and second, we get a green salad from the boiled leaves which can be another source of food nutrient for the low income families. Thru this vegetable, the vitamin and mineral requirement to maintain good health of the body is partially satisfied almost for the asking.

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