

## **BIBLIOGRAPHY**

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## **ABSTRACT**

The study was conducted at the Postharvest Laboratory of Department of Horticulture of the College of Agriculture, Benguet State University, La Trinidad, Benguet from January to February 2006; to identify and establish the best drying techniques on the leaves of mountain tea; and to determine the effect of different drying techniques on the beverage quality of mountain tea.

The beverage quality of mountain tea leaves was significantly affected by the different drying techniques used. Results showed that differences in the aroma and taste evaluation of the beverage from sun dried leaves with or without sugar were highly significant. The bitterness, color and general acceptability were significantly affected by the drying methods used as perceived by the evaluators. Nevertheless, sun dried leaves rare more aromatic and acceptable than the other methods.

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## INTRODUCTION

Benguet wild tea otherwise known as mountain tea but locally and more popularly known as “*gipas*” (*Sarcandra glabra L.*), belongs to the family Chloranthaceae. The plant is a spreading shrub that grows well in shaded or partly shaded areas in the forest. The leaves, serrated at the margins and arranged oppositely along the stem, are pleasantly aromatic when crushed. The stems are swollen at the nodes. When the plants are exposed to full sunlight, the leaves changes from green to yellowish in color and turn brittle, especially when mature.

According to Deponio (2002), “*gipas*” can be potentially grown as an indoor or backdoor plant for easy availability and use, considering the pharmacological properties of this herb. However, mass production could become a problem under high demand because it takes time to produce seedling from seeds and rooted cuttings.

According to Co (1989) as cited by Bawang (2002), this herb has numerous medicinal uses that include treatment of labor pneumonia in children; influenza, acute gastroenteritis, bacillary dysentery, appendicitis, post-operative infections, cellulites, diarrhea, ulcerating wounds, scalds, burn, traumatic injuries, bone fractures, rheumatic arthritis and stomachache. Despite these uses, however, commercial brands like Ceylon tea, lipton tea, and other seem to be more popular than this indigenous tea plant. This is because the commodity is unavailable or scarce in the market or because users have to obtain it from its natural habitats.



### Importance of the Study

Tea production is not a popular industry in the country, much less in the region. In fact, all commercial tea found in the market, and these served in restaurants or tea houses are imported. Thus, the Benguet wild tea has the potential of being grown commercially. Such potential has earned the interest for this study. One way to promote its utilization is to encourage establishment of commercial plantations to make the plant readily available.

Co (1989) as cited by Kymio 2002, who identified numerous medicinal plants in the Cordillera, however he made no mention of any side effect of *gipas*, which is generally used as beverage. In fact, the leaves have been utilized as beverage tea by many Cordillera folks for a long time and there are no reports of any negative effect up to the present. It has been recommended for the cure of several ailments of the human body. While there may be no problem about negative effects, it would still be proper to determine the composition of this plant. However, the appropriate drying techniques to enhance the best beverage quality should be established or improved. Surely, sun drying which is considered as the most practical means of means of drying might be good or air drying might be better and so with oven drying and steam drying which is used in some of the beans of processing green tea. While there are many folks already that begun the processing of the commodity, their method is unknown. So it, is really wise to discover practical means of drying that would be beneficial to prospective growers and consumers.

### Objectives of the Study

This study aims to identify and establish the best drying technique on the leaves of mountain tea and to determine the effect of different drying technique on the beverage quality of mountain tea.



### Time and Place of the Study

The study was conducted at the Postharvest Service Laboratory, Department of Horticulture, College of Agriculture, Benguet State University from January 2006 to February 2006.



## REVIEW OF LITERATURE

### The Plant

Tea (*Camellia sinensis*) is the plant from which the young and tender leaves are plucked and used for making commercial tea. It is a small evergreen tree of the family Theaceae, in the order Theales. It is closely related to the East Asian plant *Camellia japonica*. The common Camellia in its natural state *C. sinensis* grow to a height of 15 to 30 feet (4.5-9 meters); but under cultivation, it is restricted by pruning and plucking to a bush-like plant that is 2 to 5 feet (60-65 cm) tall. The tea plant has spearhead-shaped (lanceolate to ablong lanceolate), serrated leaves are borne on short stalks and are arranged alternately on the stem. They vary in length from 1.5 to 10 inches (4-25.5 cm) and in width from 0.5 to 4 inches (1.3-10 cm) mature leaves are rather thick, smooth and leathery. The fragrant flowers are produced singly or in group of two or three, are found in the axils of the leaves. The flower consists of five white petals surrounding a showy group of yellow stamen. The fruit of the plant contains one to three hard shelled dark brown capsule resembling hazelnuts (Britannica Encyclopedia 1987).

A preparation of the dried and cured leaves are made into beverage. Beverage similar to tea that are made from other plants are also called tea; but designation is almost always preceded by a modifying terms as in saffron tea or labrador tea or sage tea. The original home of this plant is believed to be Assam; but it is now grown extensively in many hilly tracts of land of India, Ceylon, China and other far-Eastern countries.

There are a under tea plantation in India is almost 4 lach hectares and the annual production is about 3 million quintals of processed tea. A large percentage of the tea area



is in Assam followed by west Bengal, Kerala and Tamil Nuda states. It is one of the important commercial crops of India, because of its export value.

Tea is one of the most important non-alcoholic beverage crops in the world and is cultivated in the tropical and sub-tropical region. Purselove (1982) pointed out that tea production is best in cool mountain areas of the tropical regions with elevation from 3,000 to 7,000 feet above the sea level. It also grows in almost all type of soil but thrives best in deep, permeable, well-drained and slightly acidic soil.

### Drying Techniques

In manufacturing of instant coffee, drying is done to obtain a uniform powder of the required characteristics, which maybe done into three processes. The spraying, agglutination and freeze drying techniques (Marshall, 1983).

Before the tobacco leaf is marketed, it must be dried first by flue-cures in a curing barn to reduce their moisture content (Rabe, 1984).

In the postharvest operation of corn they are properly dried to 18 % moisture content prior to shelling through sun drying or the use of mechanical driers. Sanitary condition are provided in all phases of grain processing, transport and storage; to avoid formation of highly toxic mycotoxins in the grains (Bawang, 2002).

The extent of drying leas depends on the type of processing to be done and on the type to produced (Bentres, 1995, Pres. Com). She added that drying of tea leaves should at least reach 0.3 % moisture content to avoid the occurrences of diseases such as molds during storage.





It is also advantageous to complete the drying of the leaves as soon as possible. The importance of ambient air and relative humidity must not be disregarded especially in drying grains in bulk (Mclean,1989).



## MATERIALS AND METHODS

### Materials

The materials in this study were fresh shoots of mountain tea , water, sticks, vat, oven, burner/stoves, tables, weighing scale, old newspaper, cup, string, thermos, spoon, sugar, and other materials will be procured as the necessity arises.

### Methods

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The drying technique treatments were as follows:

<u>Code</u>	<u>Description</u>
D <sub>1</sub>	Sun-drying (drying until the leaves are brittle)
D <sub>2</sub>	Air-drying (drying under ambient condition until leaves are brittle)
D <sub>3</sub>	Oven-dry (drying at 60°C until the leaves are brittle)
D <sub>4</sub>	Smoke-dry (drying under smoke of burning firewood)

The leaves were harvested by hand plucking from the mountain tea plants growing at the horticulture service laboratory behind College of Art and Sciences building of Benguet State University, La Trinidad, Benguet. Immediately after harvesting, the shoots were brought to the post harvest laboratory for weighing. The mountain tea was subjected to the 4 (four) drying techniques after drying, the tea was prepared for evaluation and taste-testing.



The boiling duration of the dried tea shoots were the same when boiling brewed coffee. However, the dried shoots were immediately removed from the kettle after 5 minutes. The ratio of the tea preparation was one liter of water for 10g of dried shoots.

During the taste evaluation, the evaluators were allowed to smoke or drink any beverage or take any form of snacks prior to the test. After tasting one treatment, the evaluator gargled water before tasting another treatment. The evaluators were composed of faculty/staff members and students of Benguet State University.

### Data Gathering

The data gathered was subjected to variance analysis and mean separation test by the Duncan's Multiple Range Test (DMRT) will be as follows:

#### A. Drying and Weight

1. Number of days to full drying. This was taken when all the leaves attained complete drying and when it is colored brown, there is no moisture content.

2. Weight after drying. This was obtained after all the treatments have been subjected to the different drying techniques.

#### B. Beverage Qualities

1. Aroma. This was gathered by using the following rating scale.

<u>Scale</u>	<u>Description</u>
1	Strong aroma (intense degree of smell)
2	Moderate aroma (mild or temperate degree of smell)
3	Slight aroma (extremely low degree of smell)



2. Bitterness. This was obtained after conducting taste-testing using the following scale.

<u>Scale</u>	<u>Description</u>
1	Extremely bitter
2	Very bitter
3	Moderately bitter
4	No bitter taste

3. Color. This was obtained after boiling and readying the tea for drinking using the following scale.

<u>Scale</u>	<u>Description</u>
1	Yellow
2	Brown
3	Green
4	Yellowish green
5	Yellowish brown

4. Taste evaluation. The procedure during tasting was followed and evaluated using the following scale.

a. With sugar

<u>Scale</u>	<u>Description</u>
1	Liked very much
2	Liked moderately
3	Disliked moderately



b. Without sugar

<u>Scale</u>	<u>Description</u>
1	Liked very much
2	Liked moderately
3	Disliked

5. General acceptability. This was gathered by using the following rating scale.

<u>Scale</u>	<u>Description</u>
1	Liked very much
2	Liked moderately
3	Disliked

C. Occurrence of diseases. Incidence of molds such as sooty mold was observed and recorded during the drying process.

D. Documentation of the study in pictures



## RESULTS AND DISCUSSION

### Days to Full Drying

Table 1 shows the number of days from harvesting to drying of the mountain tea leaves oven dried mountain tea leaves were significantly the fastest to attain full drying after a mean of 2.0 days; while the tea leaves dried using the air drying method were the latest with a mean of 28.67 days to full drying. These results was attributed to the characteristics of the oven to circulate warm air faster, which had a direct significant effect causing rapid loss of water on the tissues without losing much tissue composition.

However, there is a constraint in using this method since the equipment required a source of energy and causes additional expenses to operate.

Oven drying significantly enhanced earlier drying of mountain tea leaves than sun, smoke or air drying. Likewise, sun drying considerably facilitated earlier drying of leaves compared with smoke and air drying techniques.

Table 2. Shows the dry weight of mountain tea leaves as influenced by the drying techniques used. Air dried mountain tea leaves were significantly heavier than the other

Table 1. Number of days to full drying.

TREATMENT	MEAN (Days)
Sundrying	14.33c
Smoke drying	18.33b
Air drying	28.67a
Oven drying	2.00d



drying techniques used; although statistically comparable with smoke dried leaves. Oven dried leaves had significantly lower dry weight after drying. The direct effect of warm air circulating inside the oven caused rapid loss of water on the tissues without losing much of tissue composition, thus, higher weight loss resulted. However, this method required a source of energy in order for the equipment to operate; hence entails additional cost. In some commodities, sun drying is the most economical and practical means of drying after harvest to reduce moisture content and to prevent damage during storage. (Anon, 1976). Recently, Bentres (2000) reported that dried tea leaves should maintain at least 0.3% moisture content to avoid infection from diseases such as mold.

#### Beverage Qualities

The aroma ratings of the prepared mountain tea using the different drying techniques is presented in Table 3. Statistical analysis showed highly significant effect of drying techniques on the aroma as perceived by the panel of evaluators. Sundrying leaves produced tea beverage which was significantly more aromatic than the other methods of drying used.

Table 2. Weight after drying

TREATMENT	MEAN (g)
Sundrying	42.00bc
Smoke drying	50.33ab
Air drying	58.67a
Oven drying	38.00c



The results conform to the traditional practice of the old folks in which practically all the leaves are plucked, dried and boiled then used as a beverage.

(Moore et al. 1995), states that the presence in small amounts of coumarines like scopoletin and specially coumarin itself causes the characteristic odor. In harvested nutmeg, the compound present is myristrian and genaiol; and menthol, from the older leaves of mints and eucalyptus, impart the strong odors.

The bitterness of the prepared tea from mountain tea leaves using the different drying techniques is significantly affected by the sensory perception of the panel of evaluators (Table 4). Tea from sun-dried leaves had significantly bitter taste than the other methods used while air, oven, smoke dried were moderately bitter. Salisbury and Ross (1978) reported that alkaloids, which are nitrogenous compounds and which are present in plants such as tea, are often synthesized only in the shoots. Therefore, it is speculated that the shoot contain more alkaloids and terpneoids that caused the taste bitter. Nevertheless, it is not yet certain if such compounds are the ones responsible for

Table 3. Aroma rating

TREATMENT	MEAN
Sundrying	2.35a
Air drying	1.6 b
Oven drying	2. 05ab
Smoke drying	1.8ab

Means with the same letter do not differ significantly at 5% level (Bonferroni)





Table 4. Bitterness rating

TREATMENT	MEAN
Sundrying	1.5a
Air drying	1.23b
Oven drying	1.00b
Smoke drying	1.33b

Means with the same letter do not differ significantly at 5% level (Bonferroni)

bitterness in plants since Hughes and Genest (1973) suggested previously that a thousand more of alkaloids are yet to be discovered in plants.

Table 5 shows the taste of the mountain tea beverage with sugar prepared from various drying techniques as rated by the evaluators. The taste of mountain tea beverage prepared from sun dried and oven dried leaves had significantly better taste and were more acceptable than those prepared from air dried and smoke dried mountain tea leaves.

Table 5. Taste evaluation with sugar

TREATMENT	MEAN
Sundrying	2.5a
Air drying	1.8b
Oven drying	2.32a
Smoke drying	1.53b

Means with the same letter do not differ significantly at 5% level (Bonferroni)



Table 6. Taste evaluation without sugar

TREATMENT	MEAN
Sundrying	2.05a
Air drying	1.83ab
Oven drying	1.94ab
Smoke drying	1.5b

Means with the same letter do not differ significantly at 5% level (Bonferroni)

Table 6 shows the taste of the tea beverage without sugar prepared from various drying techniques as rated by the evaluators. Results show that sun dried leaves had significantly better beverage taste than the other drying methods used.

The mountain tea leaves were with moderately better taste when air dried and oven dried as shown in the results of the taste rating of the evaluators.

The colors of the tea beverage as affected by drying techniques are shown in Table 7. Results showed that the different drying techniques did not significantly affect the color of the prepared beverage. Rating of evaluators ranged from 2.40 to 3.35 which was equivalent to 5.75.

Table 8 shows the general acceptability of the tea beverage as affected by the different drying techniques by the panelists. Results showed that the general acceptability of the prepared beverage was significantly affected by the different drying techniques used. The beverage from sun-dried leaves was more acceptable to the evaluators than the beverage from other methods of drying used.



Table 7. Color

TREATMENT	MEAN
Sundrying	3.3a
Air drying	2.95a
Oven drying	3.35a
Smoke drying	2.4a

Means with the same letter do not differ significantly at 5% level (Bonferroni)

The results suggest that using high temperatures like oven drying prevented the loss of volatile compounds like coumarin (Salisbury and Ross, 1974), geraniol and mints which (Moore, et. al., 1995) accumulated in the shoots due to rapid drying. Greater loss occurred when sun or air drying techniques were used as a result of slow drying.

#### Incidence of Diseases

The incidence of sooty mold on the mountain tea leaves samples was not observed during the entire duration of the drying process and even during storage period.

Table 8. General acceptability rating

TREATMENT	MEAN
Sundrying	2.4a
Air drying	2.05ab
Oven drying	2ab
Smoke drying	1.65b

Means with the same letter do not differ significantly at 5% level (Bonferroni)



## Plates



Plate 1. The Benguet wild tea, mountain tea or gipas plant



Plate 2. Dried mountain tea leaves ready for beverage preparation





Plate 3. Faculty and student evaluators during the sensory evaluation session



## **SUMMARY, CONCLUSION AND RECOMMENDATION**

### Summary

The study was conducted at the Postharvest Laboratory of the Department of Horticulture of the College of Agriculture, Benguet State University, La Trinidad, Benguet from January to February 2006; to identify and establish the best drying techniques on the beverage quality of mountain tea leaves; and to determine the effect of different drying techniques on the beverage quality of mountain tea.

The aroma of the prepared tea beverage using the different techniques showed highly significant differences as perceived by the panel of evaluators. Mountain tea beverage from sundried leaves was significantly more aromatic than beverages using leaves prepared and dried using the other methods.

The bitterness of the prepared beverage tea was significantly affected by the different drying methods used. Sundrying method significantly produced bitter beverage tea than the other drying techniques used. The color of the tea beverage prepared from different drying techniques was not significantly affected by drying technique as perceived by the evaluators. Tea from sundried leaves was more acceptable with or without sugar compared to the other drying techniques.

Differences on the general acceptability of mountain tea beverage as affected by the different drying techniques as perceived by the panel of evaluators were highly significant. The prepared beverage from sundried leaves was more acceptable than the other drying techniques used.

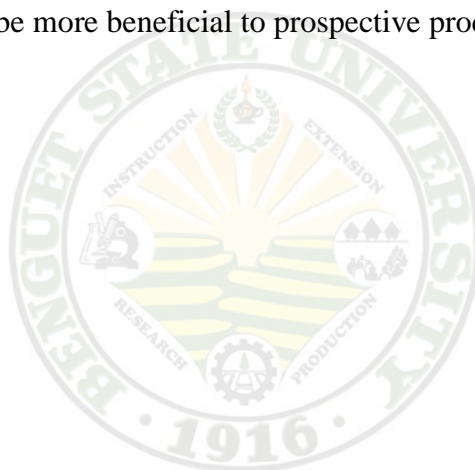


### Conclusion

Based on the results of the study, sun drying technique produced a tea beverage, which was more aromatic and acceptable to the drinkers with or without sugar.

### Recommendation

From the findings and conclusion, sun drying method of drying mountain tea leaves to be used for beverage is highly recommended. Since it was evaluated to be better in taste and acceptable to the drinkers. It is further recommended that a study along this line should be conducted to establish a more appropriate methods of processing for commercial use that can be more beneficial to prospective producers and consumers.



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## APPENDICES

Appendix Table 1. Number of days to full drying of leaves

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	II	III		
T <sub>1</sub>	14	15	14	43	14.33
T <sub>2</sub>	17	21	17	55	18.33
T <sub>3</sub>	28	30	28	86	28.67
T <sub>4</sub>	2	2	2	6	2

### Analysis of variance (ANOVA)

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	1.600	0.800			
Treatment	3	13141.733	335.443	107.0532**	3.84	7.01
Error	6	25.067	3.133			
TOTAL	11	1368.400				

\*\* - highly significant

Coefficient of variation: 12.83%



Appendix Table 2. Weight after drying

TREATMENTS	REPLICATION			TOTAL	MEAN
	I	II	III		
T1	48	35	43	126	42
T2	45	50	56	151	50.33
T3	58	48	70	176	58.67
T4	39	35	40	114	38

## Analysis of variance (ANOVA)

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Replication	2	237.733	118.867			
Treatment	3	805.733	201.433	5.7090*	3.84	7.01
Error	6	282.267	35.283			
TOTAL	11	1325.733				

\* - significant

Coefficient of variation: 12.34%



Appendix Table 3. Aroma and bitterness of the tea beverage as affected by different drying techniques

TREATMENTS	AROMA	BITTERNESS
T <sub>1</sub>	2.35a	1.5a
T <sub>2</sub>	1.6b	1.23b
T <sub>3</sub>	2.05ab	1.00b
T <sub>4</sub>	1.8ab	1.33b
F- test	**	*
Coefficient of variation (%)	1.2928	4.9304

Appendix Table 4. Taste of the tea beverage as affected by drying techniques

TREATMENTS	SUGAR	
	WITH	WITHOUT
T <sub>1</sub>	2.5a	2.05a
T <sub>2</sub>	1.8b	1.83ab
T <sub>3</sub>	2.31a	1.94ab
T <sub>4</sub>	1.53b	1.5b
F- test	**	*
Coefficient of variation (%)	2.5009	2.7386

\* significant; \*\* highly significant



Appendix Table 5. Color and acceptability of the tea beverage as affected by drying techniques

TREATMENTS	COLOR	ACCEPTABILITY
T <sub>1</sub>	3.3a	2.4a
T <sub>2</sub>	2.95a	2.05ab
T <sub>3</sub>	3.35a	2.00ab
T <sub>4</sub>	2.4a	1.65b
F- test	ns	**
Coefficient of variation (%)	1.7691	6.3037

ns -significant; \*\* highly significant

