BIBLIOGRAPHY

BAGTILA, BERNABE A. MARCH 2009. <u>Effect of the Boiling Duration and Method of Roasting on the Beverage Quality of Coffee (*Coffea Arabica*)</u>. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to determine the effects of different boiling duration and method of roasting on the beverage quality of coffee and to determine the appropriate boiling duration suitable for coffee as a beverage.

The results show that local roasting of coffee prepared as a beverage was evaluated to be more aromatic than the French roasting but are statistically comparable with the Italian method of roasting. Significant differences were also noted on the color preferences where Italian and local roasting were rated by the evaluators as dark brown in color while French roasting were perceived to be colored light brown. As to its general acceptability as a beverage, the Italian method of roasting registered the highest acceptability rating.

The different boiling duration significantly affected the aroma of coffee wherein coffee beans boiled for six minutes produced a more aromatic beverage than the coffee beans boiled for 2 and 4 minutes. Coffee beans boiled for 2 and 6 minutes effected a dark brown color, while coffee boiled for 4 minutes were perceived by the evaluators as slightly lighter in color.

Beverage from coffee roasted using the Italian method of roasting boiled for 6 minutes were generally favored and more acceptable over the other beverage preparations.

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SUMMARY, CONCLUSION AND RECOMMENDATION

INTRODUCTION

According to Uichanco (1962), he stated that coffee is an evergreen shrub, and it is commonly considered as a tree. The coffee of commerce is derived from a plant, belonging to the genus *coffea* and family *rubiacae*. The genus *coffea* has no less than 40 species of which eight are commercially grown throughout the world. These are the Arabian coffee, robusta, congo and the Liberian coffee.

Due to the invigorating effect and to some extent, it is medicinal purpose which explains its utilization, it stimulates respiratory, gastric and renal activities; it assists during assimilation and digestion; it reduces the amount of blood circulation in the brain. The coffee plant was first introduced in Pinagtungulan, Lipa and Batangas.

Coffee has a great demand in the market and has a good business promise (Danguio, 2000). Earlier Versola and Ringor (1981) recommended that coffee production is good alternative to the declining vegetable industry in the cordillera. It is one of the precious beverages being consumed by Filipinos.

Attesting to this fact, a few homes from north to south of the country are without coffee to grace their tables. This shows the popularity of the commodity in the entire Philippine Archipelago.

This study was conducted as a guide for coffee drinkers on the appropriate duration that is preferred to satisfy them in taking coffee as beverage. Charles B. Heiser Jr. (1973); stated that man discovered that certain plant parts of various plants could serve as man's chief sources of non-alcoholic beverages. The most significant are coffee, tea, cacao and mate or Paranguay tea. These plants, all members of different botanical

families, share an important feature in common, the possession of caffeine or very similar alkaloid that is responsible for its stimulating properties. Except for cacao these plants offer man little in the way of nutrition, and tea are not strictly speaking, food plants, they are extremely important export crops in many parts of the tropical world and figure prominently in the economic welfare of many countries.

In this regard, coffee drinkers may serve as basis for individuals interested in knowing which is best acceptable between the boiling duration of Arabica coffee. Moreover, it may provide valuable information to researchers conducting other studies with regards to beverage acceptability.

The objectives of the study were to determine the effects of the different boiling duration and method of roasting on the beverage quality and acceptability of coffee; and to determine the appropriate boiling duration suitable for coffee as a beverage.

The study was conducted at the Horticulture Department service laboratory, Benguet State University, La Trinidad, Benguet on January 18, 2008.

REVIEW OF LITERATURE

<u>Description of the Plant</u>

Benguet coffee (*coffea* Arabica) has the best cup quality due to its excellent flavor and aroma (PCARRD, 1999). The plant is glabrous shrub smaller than *liberica* and Robusta trees. The lateral branches are opposite in arrangement. They are averaging 12 to 15 cms. long and about 6 cms wide oval or elliptical, shortly at the base.

(Janick, 1981), stated that the genus *coffea* is a large one, numbering about 40 species only two of these species have attained commercial importance for the fruit or berry. C, Arabica (accounting for about 75 percent of the coffee crop), and caffeine-rich *canephora* ("*robusta*" coffee, mainly produced in Africa, and especially suitable for making "instant" coffees). The species C. Arabica is *tetraploid* with 44 chromosomes and is self compatible; all other species are diploid with 22 chromosomes and are apparently self-incompatible.

Ringor and Versola (1981) stated that coffee Arabica belong to the species of Erytho coffea, which originated from Ethiopia, it grows 4 to 5 meters high. However, it may reach a height of up to 10 meters.

<u>Importance of Coffee Boiling</u>

Despite the name boiling, care should be taken not to actually boil coffee or at least not for too long because that would make it bitter.

The simplest method is to put the ground coffee in a cup, pour hot water over, and let it stand, cool and allow the grounds to sink to the bottom. This is a traditional method

for making a cup of coffee that is still used in parts of Indonesia. One should not drink this to the end unless one wants to "eat" the ground coffee. The advantage of this method is that it is simple and that the water temperature is just right (Anon, undated).

In the Middle East, North Africa, east Africa, Turkey and Greece, water is placed all together with finely ground coffee in a narrow-topped pot, called an *ibrik* (Arabic), *cezve* (Turkish), *kanaka* (Egyptian), *bouriki* (Greek), or *dzezva* (Stokavian), and allowed to briefly come to boil. It is usually drunk sweet, in which case sugar is added to the pot and boiled with the coffee (Anon, undated).

Boiling is done in order to create the beverage quality of coffee it is usually taken after boiling or when it is still hot to smell strong aroma.

Boiling coffee is to bring out the aroma and some chemicals extracted by hot water like non-volatiles taste components and volatile aroma components. Important non-volatiles are caffeine, chlorogenic acids, amino acids, carbohydrates, and minerals and important volatiles or organic acids, aldehydes, esters, and amines. The principal physiological effects of boiled coffee are produce by caffeine, an alkaloid that acts as a mild stimulant (Anon, undated).

Effect of Coffee as Beverages on Physical Health

Coffee contains alkaloids, which acts as a stimulant. For this reason, it is often consumed in the morning and during working hours. Student preparing for examination will drink coffee late at night to maintain their concentration. Many office workers take a coffee break when their energy is diminished (Anon, undated).

Many people drink coffee for its ability to increase short term recall and increase IQ. It also changes the metabolism of person so that their body burns a higher proportion of lipids to carbohydrates, which can help athletes avoid muscle fatigue (Anon, undated).

MATERIALS AND METHODS

Materials

      The materials used in this study were roasted coffee beans (Arabica coffee) which were taken at the Benguet State University, Marketing Center at La Trinidad, Benguet, kettle, mugs, sugar, water, tablespoon, frying pan and other needs during the preparation.

Methods

      Roasting method. French system of roasting, the beans were roasted until the natural oil appears on the surface with appearance of dark brown; in the Italian system, the beans were roasted until they turn almost black in color while in the local system, the beans were roasted until they turn totally black in color.

      Beverage preparation. The roasted coffee bean was boiled following the different treatments for evaluation. In the system of boiling, when the water reached the boiling point, the ground coffee beans were boiled following the treatments. The mixture was three tablespoon of powdered coffee per liter and after boiling in every one eight ounce of cup was mix to a twenty grams of white sugar.

Experimental Design and Treatment

      The experiment was laid out in a completely randomized design (CRD)following factorial arrangements with roasting method as Factor A and boiling duration as Factor B.

Factor A – Method of Roasting	Factor B – Boiling Duration
Code	Code
R_1 – French roasting	B_1 – 2 minutes
R_2 – Italian roasting	B_2 - 4 minutes
R_3 – local roasting	B_3 – 6 minutes

<u>Evaluation</u>

The evaluators or taster should have not smoked or drunk any beverage and taken any form of snacks prior to the taste test. After testing one treatment, the evaluator will drunk water to remove the taste of the other treatment tasted prior to testing the next treatments. The evaluator was composed of adults, the age ranging from 20 years old and above. They were chosen at random so that there were thirty evaluators.

<u>Data Gathering</u>

The data gathered were as follows:

1. Beverage Qualities

    a. Aroma

<u>Scale</u>	<u>Description</u>
4	Strong aroma
3	Moderate aroma
2	Slight aroma
1	Poor aroma

    b. <u>Color</u>

<u>Scale</u>	<u>Description</u>
4	Black
3	Very dark brown
2	Dark brown
1	Light brown

2. General Acceptability

    4 - like very much
    3 – like moderately
    2 - dislike moderately
    1 – dislike very much

RESULTS AND DISCUSSION

Aroma Preference

Effect of kinds of roasting. Table 1 show significant differences on the aroma of coffee as influenced by the different method of roasting. Numerically, local roasting of coffee beans was rated by the evaluators to be more aromatic than French roasting but is statistically comparable with the Italian roasting. Based on the findings, the result may imply that local roasting of coffee beans results to stronger aroma than French and Italian roasting. The above results agrees with the findings of Salupen (2003) in her study wherein she found out that local roasting enhanced better aromatic characteristics when prepared as a beverage.

Effect of boiling duration. Statistical analysis showed no significant influence of the boiling duration on the aroma rating of coffee. However, numerical results revealed that local roasting of coffee boiled for 6 minutes gave the highest aroma rating followed by coffee boiled for 2 minutes. The least rating was obtained on the boiling duration of 4 minutes.

The result suggests that boiling duration in local roasting of coffee for 6 minutes tend to enhance better aromatic characteristics because based on the results, most of the evaluators preferred coffee having a 6 minutes boiling duration over the other treatments.

Interaction effect. Significant interaction was observed between roasting and boiling duration of coffee in so far as the aroma of coffee beverage is concerned. (Fig. 1).

Table 1. Aroma

TREATMENT	MEAN*
Factor A	
R_1 – French roasting	2.16b
R_2 - Italian roasting	2.76a
R_3 – Local roasting	2.98a
Factor B -Boiling duration	
B_1 – 2 minutes	2.58a
B_2 - 4 minutes	2.56a
B_3 – 6 minutes	2.74a

Means followed by a common letter are not significantly different at 3% level of DMRT

*Rating scale and description: 4 - strong; 3 – moderate; 2 – slight and 1 – poor

Result showed that coffee preparation produced from local roasting with a boiling duration of 6 minutes was perceived by the evaluators as having the best aroma over the French roasting boiled for 2, 4 and 6 minutes respectively. However, the Italian method of roasting was comparable with the local method of roasting. Likewise, the local method of roasting boiled for 6, 4 and 2 minutes were not significantly different with the coffee boiled using the Italian roasting with same boiling durations.
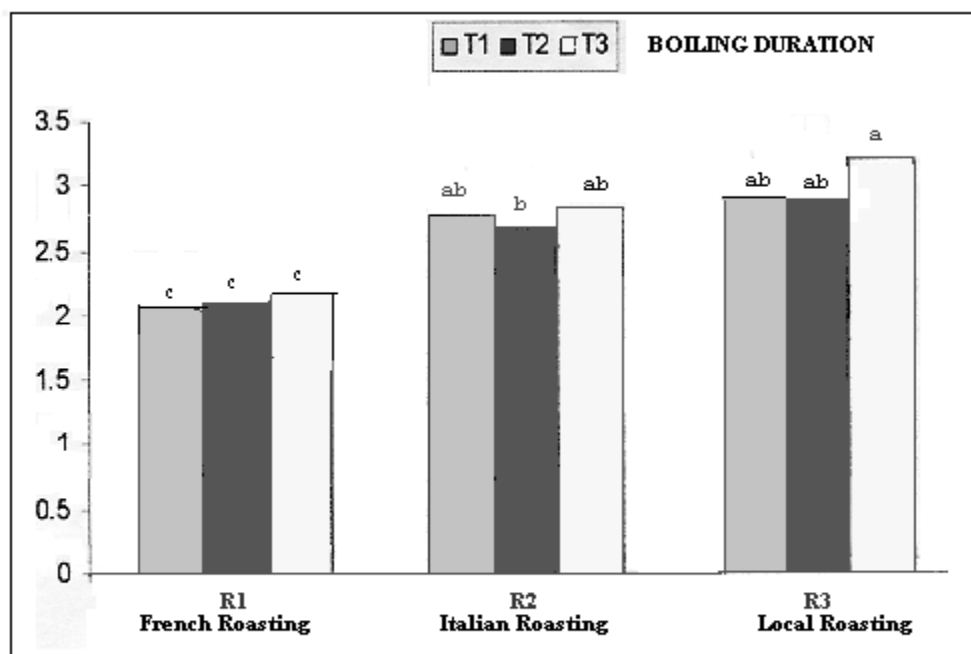
Figure 1. Aroma

Color Preference

Effect of the methods of roasting. The color rating of coffee beverage as affected by the different methods of roasting is shown in Table 2. Results revealed that there were significant differences between the methods of roasting of coffee as a beverage. Italian and local roasting were rated by the evaluators as dark brown in color while French roasting were perceived to be colored light brown suggesting that Italian and local roasting tend to effect color change. The result further suggests that there is color change of coffee beans when processed and prepared as a beverage.

Effect of boiling duration. Table 2 presents the color rating of coffee as affected by the different boiling durations. Result showed that there were significant influences of the different boiling durations on the color of coffee such that the evaluators rated the coffee boiled for 6 minutes to be dark brown in color as compared to the coffee boiled for 2 minutes and 4 minutes, wherein it was rated to be light brown in color although both treatments are comparable with each other.

Table 2. Color

TREATMENT	MEAN*
Factor A	
R_1 – French roasting	1.44b
R_2 – Italian roasting	2.25a
R_3 – Local roasting	2.31a
Factor B -Boiling duration	
B_1 – 2 minutes	1.91b
B_2 – 4 minutes	1.86b
B_3 – 6 minutes	2.23a

Means followed by a common letter are not significantly different at 5% level of DMRT

*Rating scale and description: 4 - black; 3 – very dark brown; 2 – dark brown and 1 – light brown.

Interaction Effect. Significant interactions were noted between the methods of roasting and boiling durations of coffee as far as the beverage color is concerned. Figure 2 showed that the coffee beverage prepared and boiled from the different boiling durations using the Italian roasting were not significantly different with the preparation of coffee beverage using the Italian roasting. While the local and Italian method of roasting was significantly different with the French method of roasting. However, the coffee

beans boiled for 4 minutes were perceived by the evaluators as slightly lighter in color as compared with the coffee beans boiled for the different boiling duration using both the local and Italian roasting. The French roasting was observed to have produced the lightest color with regards to the method of roasting and boiling durations.
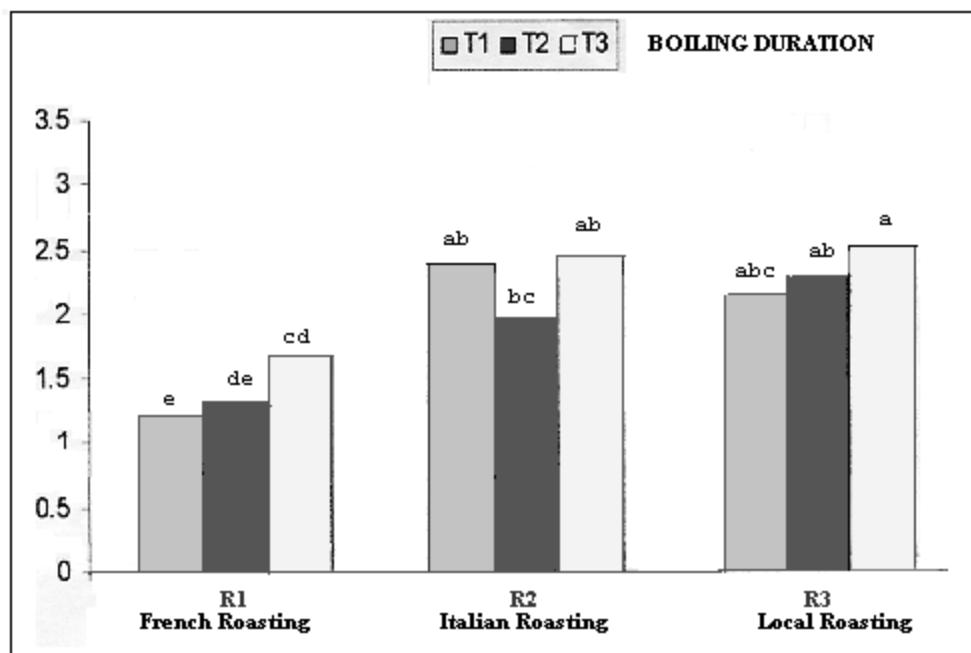

Figure 2. Color

General Acceptability

Effect of the methods of roasting. Table 3 shows the general acceptability rating of coffee beans prepared as a beverage as affected by the different methods of roasting. The result indicates that Italian roasting registered the highest numerical acceptability rating but statistically comparable with the local roasting. Based on the taste test

evaluation, it is very evident that Italian roasting of coffee is more acceptable and much preferred than French and local roasting as far as the evaluators are concerned.

Effect of boiling duration. The general acceptability of coffee as affected by the different boiling duration is shown in Table 3. The boiling durations did not significantly affected the general acceptability as was rated by the evaluators. However, numerical results showed that the coffee beans boiled for 6 minutes was more acceptable for the evaluators as compared to the coffee beans boiled for 4 and 2 minutes.

Table 3. General acceptability

TREATMENT	MEAN*
Factor A	
R_1 – French roasting	2.57b
R_2 – Italian roasting	2.96a
R_3 - Local roasting	2.86a
Factor B - Boiling duration	
B_1 – 2 minutes	2.74a
B_2 – 4 minutes	2.78a
B_3 – 6 minutes	2.87a

Means followed by a common letter are not significantly different at 5% level of DMRT

*Rating scale and description: 4 – like; 3 – like moderately; 2 – dislike moderately and 1 – dislike very much

Interaction Effect. There were significant differences that were observed between roasting and boiling duration in so far as the general acceptability is concerned. (Fig. 3).

The local roasting and Italian roasting did not differ significantly with each other despite the boiling duration as perceived by the evaluators. However, the coffee beans

roasted using French method that was boiled for 2 and 4 minutes significantly differed with the other treatments combinations.

Based on the results, it was found out that the Italian method of roasting coffee beans boiled for 4 and 6 minutes were generally preferred by the evaluators.
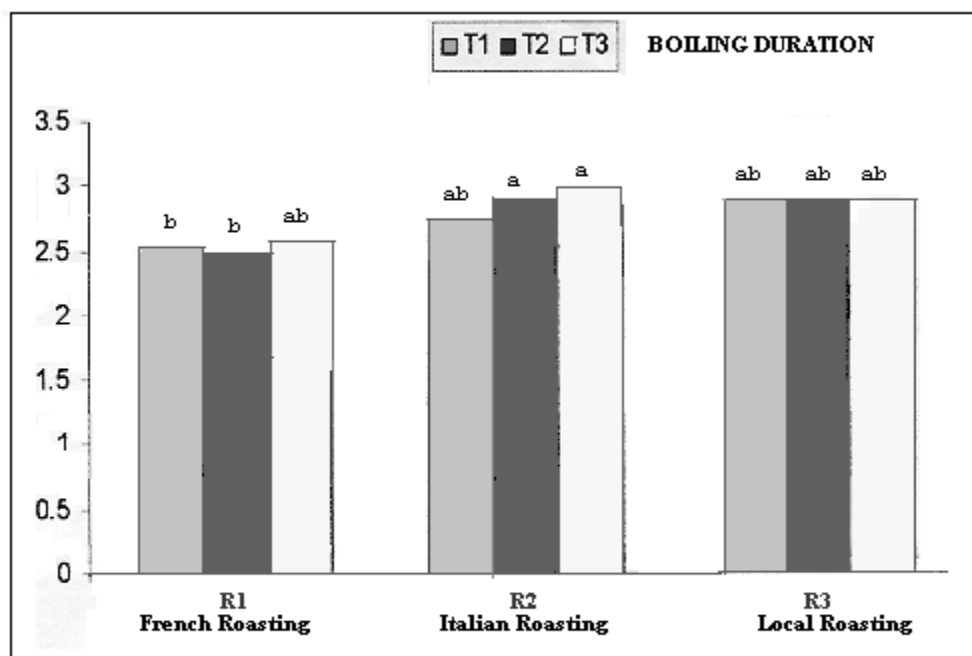

Figure 3. General Acceptability

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Benguet State University, La Trinidad, Benguet from January 18, 2008 to determine the effects of different boiling duration and method of roasting on the beverage quality of coffee and to determine the appropriate boiling duration suitable for coffee if prepared as a beverage.

The result shows that local roasting of coffee was significantly more aromatic than the French method of roasting but statistically comparable with the Italian roasting. However, beverage prepared from Italian and local roasting were evaluated by the panelist to be dark brown in appearance, and French roasting were rated to be light brown in color. There was a slight significant difference on the beverage acceptability rating. Likewise, numerically, Italian roasting registered the highest acceptability rating over French and local roasting.

Roasted coffee beans boiled for 6 minutes registered the highest aroma rating of coffee followed by the coffee beans roasted and boiled for 2 minutes. The least rating was obtained with boiling duration of 4 minutes. Likewise, significant effects of the boiling duration were observe on the color of coffee wherein roasted coffee beans boiled for 6 minutes was rated to be dark brown in color while coffee beans boiled for 2 and 4 minutes yielded a light brown appearance. Nevertheless, coffee boiled for 6 minutes had the best acceptability followed by roasted beans boiled for 2 and 4 minutes.

Local roasting with a boiling duration of 6 minutes produced the most aromatic beverage; while local roasting boiled for 2 and 4 minutes was rated the least aromatic

with the lowest rating. Likewise, French and locally roasted coffee beans and boiled for 2 and 4 minutes did not significantly differed much. The beverage prepared from local roasting and was boiled for 6 minutes was rated by the evaluators to be dark brown in color while the coffee beans roasted thru French and Italian method of roasting that was boiled for 2 and 4 minutes had a light brown in color. Italian and local roasting boiled for 6 minutes was significantly rated by the evaluators as the most preferred beverage, while coffee beans prepared by French roasting boiled for 2 and 4 minutes were rated to be disliked very much.

Conclusion

Based on the result of the study, it is concluded that coffee roasted using local roasting could be used as a beverage. The Italian and local roasting of coffee beans are more aromatic than French roasted coffee beans but in terms of acceptability, the coffee beans boiled for 6 minutes using the Italian method of roasting is more accepted by the evaluators over the other treatments. In terms of color, the Italian and local method of roasting enhanced darker brown color while the French roasting effected a lighter brown color when the coffee beans was prepared as a beverage.

Recommendation

Based on the proceeding results and discussions it is recommended that Italian method of roasting with a boiling duration of 6 minutes will produce an aromatic and acceptable coffee beverage.

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APPENDICES

Appendix 1. Aroma

Analysis of Variance

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SUM OF SQUARES	COMPUTED F	Pr > F
Model	8	35.866	4.483	5.55	0.0001
Roast	2	33.266	16.633	20.59	0.0001
Boil	2	1.688	0.844	1.05	0.3530
Roast * Boil	4	0.911	0.227	0.28	0.8845
Error	261	210.833	0.807		
CORRECTED TOTAL	269	216.700			

R – square	C. V.	Root MSE	Y1 MEAN
0.145	34.130	0.898	2.633

Appendix Table 2. Color

Analysis of Variance

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SUM OF SQUARES	COMPUTED F	Pr > F
Model	8	52.696	6.587	8.50	0.0001
Roast	2	42.362	21.181	27.33	0.0001
Boil	2	7.207	3.603	4.65	0.0104
Roast * Boil	4	3.125	0.781	1.01	0.4037
Error	261	202.300	0.775		
CORRECTED TOTAL	269	254.996			

R – square	C. V.	Root MSE	Y1 MEAN
0.206	43.938	0.880	2.003

Appendix Table 3. General Acceptability

Analysis of Variance

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN SUM OF SQUARES	COMPUTED F	Pr > F
Model	8	8.896	1.112	1.47	0.0511
Roast	2	3.670	3.670	6.49	0.0018
Boil	2	0.414	0.414	0.73	0.4814
Roast * Boil	4	0.725	0.181	0.32	0.8640
Error	261	147.700	0.565		
CORRECTED TOTAL	269	156.596			

R – square	C. V.	Root MSE	Y1 MEAN
0.056	26.831	0.752	2.803