Classical Charcoal Making And Properties Of The Charcoal From Palmyra Palm Shell As The Traditional Community Practice

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Abstract
Survey on classical charcoal making from Palmyra palm shell as the traditional community practice at Ramdang, Songkhla was carried out. Results revealed that as for the community way of life. The first experiment involved with quality assessment of charcoal obtained from 4 traditional charcoal making methods. Treatments were compared using Randomized Complete Block Design (RCBD) with 4 replications. Three factors being assessed were chemical, physical and fuel properties. Results showed that burning charcoal in a circular pit using 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (M4) gave maximum charcoal yield, charcoal weight/pit and weight /shell (51.25 g/shell) with the least weight of cracked charcoal/pit (800 g) and statistical significant different from other methods ($p<0.05$). Burning charcoal in a square pit using 1:1:1 ratio of staminate inflorescence, rice straw and husk (M2) provided high levels of volatile substances and stable carbon which were significantly different from other methods ($p<0.05$). These meant that the method had carbon as the major stable molecular components resulting in a better combustion process but the amount of ash was high. The second experiment was on the effect of fuel materials on quality of the charcoal. Results revealed that the treatment having 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (S4) gave maximum charcoal yield and charcoal weight/shell. The other treatment having 2:1:2 ratio of staminate inflorescence, dry leaves and rice husk (S3) provided high and significant level of stable carbon resulting in a better combustion process, high ignition temperature and rapid burning due to low humidity.

Keywords: Charcoal from Palmyra Palm Shell, Biomass Energy

Introduction

Palmyra palm (Borassus flabellifer) is locally known as the sugar palm or “Tan” or “Tan Ta Not” in Thai. The by-products of palm sugar production, including the exocarp– stems, fruit calyx and husks – and endocarp,are discarded as waste and adversely affect human health and the environment both in the community and along the main roads. A survey revealed that every bunch with 1-20 young fruits produces waste amounting to 90% of the original weight after the fruits is removed; 60% endocarp per seed is left over.

Traditional charcoal making process in Ramdang Community is a part of the local way of life, which relates to Palmyra palm tree, rice field, bamboo and human. According to the process, local people normally pick ripe palm shell then dry up and burn until it becomes Palmyra palm shell charcoal. People in the community use palm shell charcoal in cooking and some for trading. The charcoal production process normally used rice straw, husk and staminate inflorescence as main fuel. The charcoal from the process as a result has high carbon level and no humidity. This qualified gave high energy to the charcoal when comparing to the dried wood. The process in turning organic substance into charcoal was called “Carbonization”. (Tharinee, 2005)

The study used the comparison method in producing process and the charcoal quality from traditional charcoal making in Laadkrating, Sanamchai, Chachoengsao and Department of Forestry from three 8 cubic meters charcoal kilns. The acacia wood was put in the first and the third kiln while eucalyptus wood was put in the second kiln. According to the experiment, it was found out that the producing method from the Department of Forestry gave 920.77 kg. (32.20%) while the traditional process gave only 894.66 kg. (28.96%). The traditional charcoal process tended to give fewer charcoal. It was also assumed that it was the result from the firewood. According to the usage of firewood, the traditional process used approximately 185.4 kg when comparing to the Department of Forestry used only 112.7 kg. In another case, the experiment from rubber charcoal gave the product only 26.18% while the coconut shell gave the product 37.33%.

When the study of heating value from rubber compared with coconut shell and charcoal, the given heat were 2333.33, 2516.67 and 1600 calories in order. The rubber charcoal used only 32.33 minutes and ashes only 5.35% but the quality was lower than coconut shell charcoal. The burn off rate was higher than normal charcoal (11.85%). The heat experiment showed that durian shell gave higher heating value than Eucalyptus. (Tipawan and Ancharika, 2546). Referring from Kedkanok and Wittawat’s study (2546), it was found out that charcoal, which gave the highest heating value, was bagasse and cassava with 4:1:1 ratio of staminate inflorescence while bagasse and cassava with 3:1:1 ratio of staminate inflorescence gave the least heating value. However, the most appropriate ratio of staminate inflorescence is 2:1:1. Therefore, Palmyra palm shell was local material fuel in Rumdang community, Songkhla Province.

The study therefore examined the feasibility of producing palmyra palm shell and local agriculture leftover as main fuel in charcoal making process.

Research Methodology

The research methodology can be divided into 2 experiments as followed;
The first experiment involved with quality assessment of charcoal obtained traditional charcoal Palmyra Palm Shell making methods in Ramdang Community.

The study began with discussions between researchers and the local community to work together to utilize Palmyra palm crop residues as a valuable commodity and at the same time benefit the local environment. Based on the King's initiatives, the study combines scientific knowledge with public participation at community level, including local farmers, monasteries, educational institutions, and local administrative organizations. The study highlights the need to implement such initiatives to ensure a balance among economic, social and environmental parameters in contributing towards realizing the goal of community energy independence.

The randomized trial consists of 4 different burning process together with local fuel, which were; circular pit using 1:1:1 ratio of staminate inflorescence, rice straw and husk (M1), square pit using 1:1:1 ratio of staminate inflorescence, rice straw and husk (M2), square pit using 2:1:2 ratio of staminate inflorescence, ash and rice husk (M3) and circular pit using 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk(M4). Density, weight, product, ash content, volatile matter and heating value would be analyzed from the chemical properties, physics and proper fuel for Palmyra palm charcoal.
The second experiment was studied the effect of fuel materials on quality of the Palmyra palm shell charcoal. The burning method was appropriate for the second experiment and was approved by Ramdang community. The randomized trial consisted of choosing local fuel with 4 ratio of fuel materials in circular pit, which were; having 1:1:1 ratio of staminate inflorescence, rice straw and rice husk (S1), 1:1:2 ratio of staminate inflorescence, rice straw and husk (S2), 2:1:2 ratio of staminate inflorescence, dry leaves and rice husk (S3) and 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (S4).

Result

The study aimed to conduct a study to examine the benefits of using the raw materials which provide a naturally balanced and environmentally friendly alternative use of the by-products.

According to the first experiment, the result from comparing the quality of Palmyra palm shell charcoal from traditional charcoal making methods in Ramdang Community is as below;

The color, humidity and pH of the charcoal in Ramdang Community had no different from each other. In other word, Palmyra palm shell charcoal from all of pits are black, the value keys level equal 1, pH of Palmyra palm shell charcoal ashes was 9.5 and the average humidity was 30%. It was also found out that a circular pit using 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk(M4) gave maximum charcoal yield, charcoal weight/pit and weight /shell (51.25 g/shell) with the least weight of cracked charcoal/pit (800 g) and statistical significant different from other methods ($p<0.05$)(table 1).

Table 1 Shows the quantity, length and width of the Palmyra palm shell charcoal from different production method

Production method	No./pit	Weight/pit (g.)	Cracked charcoal/pit (g.)	Weight/shell (g.)	Length (cm.)	Width (cm.)
M1	45.00 ab	1850 ab	1225 a	48.50 b	65.28	67.21
M2	33.00 b	1350 b	1350 a	50.00 ab	67.49	72.71
M3	48.25 ab	1925 ab	1225 a	49.50 ab	60.75	74.18
M4	61,00 a	2325 a	800 b	51.25 a	68.72	73.93
CV %	22.10	23.68	22.52	1.71	7.88	5.31

Means in each column that followed the same letters are not significantly different at $p< 0.05$ by DMRT

While using square pit with same elements with the portion 1:1:1 as a fuel. M2 will gave higher volatile matter and fixed carbon, which statistical significant different from other methods ($p<0.05$). It could be seen that the molecule of the volatile matter affects the combustion. Since most of the molecule combines of carbon, it helped the combustion process too. However, each type of the production method did not affect the heating value and density. According to table 2, 4 methods of the traditional Palmyra palm shell charcoal gave different result. The circular pit was selected and inflorescence, rice straw husk and dry leaves as the main fuel which would lead to the research of finding proper fuel.

Table 2 Shows the density, volatile matter, fixed carbon, heating value (cal/g) and ash percentage from different production method of the Palmyra palm shell charcoal

Production method	Density (g/cm)	Volatile Matter (%)	Fixed carbon (%)	Heating value (cal/g)	Ash (%)
M1	0.44	70.325 a	24.25 ab	4327.50	4.42 b
M2	0.49	69.465 a	26.57 a	4430.25	7.65 a
M3	0.60	65.825 b	24.07 b	4691.25	4.52 b
M4	0.61	65.475 b	21.07 c	4458.75	3.52 b
CV %	26.23	3.35	4.62	4.14	10.99

Means in each column that followed the same letters are not significantly different at $p< 0.05$ by DMRT

The second experiment was studied the influence of various types of fuel in Palmyra palm shell charcoal production process. The results were as followed;

The color, humidity and basicity of the charcoal in Ramdang Community had no different from each other. Every method gave black Palm shell charcoal, which the value key equal 1, the pH level was 9 and the average humidity was 28.5%. It was also found out 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (S4) gave maximum charcoal yield and charcoal weight/shell (59 no. charcoals/pit, 2,265 grams. of weight/pit). The statistic of this method was quite similar to the first method as showed in Table 3.

Table 3 Shows the amount, weight, length and width of the Palmyra palm shell charcoal using different ratio of fuel

Type of fuel	No./pit	Weight/pit (g.)	Cracked charcoal/pit (g.)	Weight/shell (g.)	Length (cm.)	Width (cm.)
S1	46.00 ab	1780 ab	1495 a	49.00	68.78	65.81
S2	35.00 b	1350 b	1850 a	49.50	63.88	74.64
S3	47.25 ab	1825 ab	1725 a	49.25	63.93	71.49
S4	59.00 a	2265 a	1005 b	49.00	62.19	70.43
CV %	4.56	6.89	8.34	3.60	8.43	8.98

Means in each column that followed the same letters are not significantly different at $p< 0.05$ by DMRT

While 2:1:2 ratio of staminate inflorescence, dry leaves and rice husk (S3) provided highest fixed carbon and significant level of resulting in a better combustion process, high ignition temperature and rapid burning due to low humidity. It showed that molecule structure combines of carbon, which also helped the combustion process. The process also gave less ash when comparing to other production method. Somehow, fuel resource did not cause any effects to density, volatile matter , heating value, weight, width and length of the Palmyra palm shell charcoal, as showed in table 3 and 4.

Table 4 Shows the density, volatile matter, fixed carbon, heating value (cal/g) and ash percentage from different ratio of fuel

Type of fuel	Density (g/cm)	Volatile Matter (%)	Fixed carbon (%)	Heating value (cal/g)	Ash (%)
S1	0.55	73.30	23.77 bc	4458.75	3.70 c
S2	0.55	72.79	24.50 b	4886.25	7.07 b
S3	0.56	70.92	25.80 a	4647.75	2.45 d
S4	0.50	72.10	22.70 c	4404.50	8.37 a
CV %	6.69	2.42	2.24	4.63	6.15

Means in each column that followed the same letters are not significantly different at $p< 0.05$ by DMRT

Conclusion

The study indicates that the charcoal making process a circular pit using 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (M4) gave highest product and had the least breaking charcoal. Furthermore, gave lower rate cracking charcoal than square pit. However, the most appropriate portion charcoal making process using 3:1:3 ratio of staminate inflorescence, dry leaves and rice husk (S4) gave the high quality product. While using 2:1:2 ratio of staminate inflorescence, dry leaves and rice husk (S3) gave high percentage of fixed carbon.

It can be concluded that molecule structure combines of carbon affects combustion process and gave lower percentage of ashes. In other word, organic component of

palm shell was result to charcoal making quantity. With little crackle, long combustion time and low levels of odour and smoke, the could be suitable for use in households and restaurants. In addition to contributing a supplementary source of revenue for framers, palmyra palm shell charcoal making helps maximize resource utilization, reduce the volume of waste and minimize their environmental impacts. Further work may explore refinements of the mixing rations to suit specific needs. These research findings may be readily implemented in communities with large quantities of palm waste, particularly in the other provinces of Thailand.

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