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Model Program Processing of Fishbone Waste Transfer for the Application of Drinking Water Products and Test Characterization

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Abstract. The fish bone waste treatment program for the application of useful products, specifically as a natural ingredient of the drinking water filter. This program works with coastal communities in terms of providing raw materials. This program is a social innovation from the transfer of knowledge of the university's inventors to the coastal communities, in the aim to maintain and improve the cleanliness of the environment, which is then applied for the purpose of developing a water filter system. The contribution of this organic product is useful for Small, Micro & Medium Enterprises engaged in the production of food and beverages, as well as donations for cosmetic and health products to industries, as well as donations to policy development, through the application of environmental physics and science development to product development, pre-commercialization and commercialization (social engineering & manufacturing). The involvement of coastal communities in utilizing their waste is to achieve the empowerment of coastal communities, emphasizing community involvement to learn and cooperate for future development goals. Prior to the formation of this program, the community who failed to take care of its waste often had the waste dumped into the sea, rivers and garbage collection sites. The disposal causes the form of pollution problems that invite various dangerous diseases and cause the community environment to be clean, smelly and diseased. The results of the research have been done, Fish bone waste can be processed to be a product of water filter system resulting from fish processing industry, which contains high calcium. Fish bones are very rich in calcium that is needed by the human body, because the main elements of fish bones are calcium and phosphorus. The use of fish bone calcium is widespread such as overcoming coastal pollution and other environments in the disposal of heavy metals such as Zinc (Zn), Copper (Cu), Lead (Pb), and Iron (Fe).

Keyword:processing, waste, innovation, filter, water.

1 Introduction

From the research conducted on 50 people in coastal community of Kuala Terengganu, Malaysia, it is found that there has no public socialization ever conducted to educate people about the benefits of fish bone waste (86.7%). People there also do not know the use of fish

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bone waste that they sell to the aquaculture entrepreneurs who freely collect the waste all this time (63.3%) [1-4]. Based on the survey, the researcher conducted an analytical study "need assessment" to the fisherman community, which results produce the organic water filter for coastal residents [5-11]. The study uses social innovation model via waste management technology.

There are approximately 119 million people in Indonesia do not have access to clean water [12-14]. Only 20% people are able to use clean water for their daily activities, mainly those who reside in the cities. This means that there are still 82% of Indonesian people who are forced to use the unhealthy water. The percentage of clean water access in rural areas of Indonesia is lower than some neighbor countries such as Malaysia.

Indonesia government has conducted numerous coaching programs in regards to water treatment in all provinces and some rural areas in Indonesia. But the crisis of clean water is still found, especially in the remote areas. The quality of water supply in Indonesia is declining as the water is increasingly polluted due to the outdated system of water filter. The increased pollution in water sources and rivers cause a slump of quality in water supply, aside from other pollutants such as corrosion, dust, sand etc inside the old asbestos pipes.

Through the study in this paper, there is one innovation to increase the quality of drinking water. This study is conducted as the responsibility of the University, as a contribution to the public health office and National Food and Drugs Agency to ensure the availability of water, also as the standard and guidelines for water operator in supplying water [15-20].

The use of water filter and bottled water among Indonesian customers are considered competitive in terms of filtering the organic alkaline content, the halalness and the wholesomeness. The tight standard procedure hence does not raise issues in public, for example the issue that carbons are made of pork bones.

2   Materials and Methods

The source of filter media is the calcium collected from fish bone waste from East Coast Malaysia. The fish bone waste was obtained from the remaining process of cracker factory at Kuala Terengganu Malaysia. The fish bones were cleaned with water and then boiled and dried. The bones were then mashed with a blender, and grinded to powder at Kuala Terengganu. Afterwards, powder was taken to SIRIM Berhad Shah Alam Malaysia to be heated in a furnace, producing fish bone calcium. While the water sample for water quality test was taken from the pond at Universiti Malaysia Terengganu (UMT) Malaysia, also from Tambunan Langkat Village, North Sumatra. The obtained fish bone powder was then characterized by using SEM – EDAX and AAS at the research laboratory of Universiti Kebangsaan Malaysia (UKM), Internasional Islamic Universiti Malaysia (IIUM), Universiti Putra Malaysia (UPM) and SIRIM

Berhad Malaysia. The X-RF test towards the fish bone sample was done at BATAN Puspiptek Serpong Tangerang Banten and research laboratory at Faculty of Pharmacy of Universitas Sumatera Utara (USU).

3   Result and Discussion

From the AAS (Atomic Absorption Spectroscopy) test, it is stated in table 1 and 2 that Calcium Hydroxyapatite (CaHAp) from fish bones is effective to the removal of Heavy Metal; Zinc (Zn) and Lead (Pb), each by 103% and 95%, the Activated Carbon (AC) of fish bones is effective to the removal of copper (Cu) by 107%, while the Activated Carbon and Hydroxiapatite (AC+HAp) affect the decrease of Zinc by 80%.
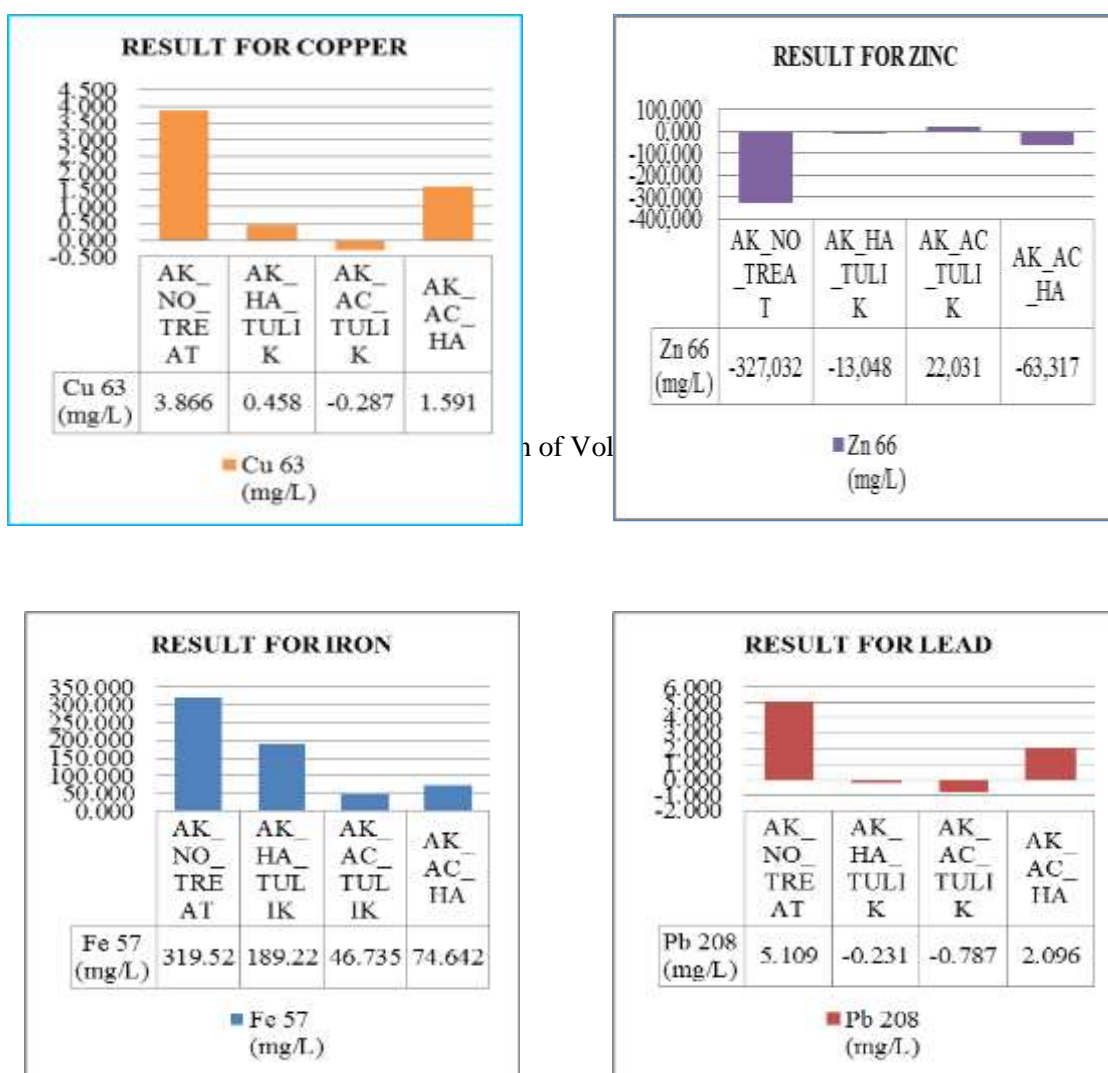
RESULT FOR COPPER

	AK_ NO_ TRE AT	AK_ HA_ TULI K	AK_ AC_ TULI K	AK_ AC_ HA
Cu 63 (mg/L)	3.866	0.458	-0.287	1.591

■ Cu 63 (mg/L)

RESULT FOR ZINC

	AK_NO _TREA T	AK_HA _TULI K	AK_AC _TULI K	AK_AC _HA
Zn 66 (mg/L)	-327,032	-13,048	22,031	-63,317

■ Zn 66 (mg/L)

RESULT FOR IRON

	AK_ NO_ TRE AT	AK_ HA_ TUL IK	AK_ AC_ TUL IK	AK_ AC_ HA
Fe 57 (mg/L)	319.52	189.22	46.735	74.642

■ Fe 57 (mg/L)

RESULT FOR LEAD

	AK_ NO_ TRE AT	AK_ HA_ TULI K	AK_ AC_ TULI K	AK_ AC_ HA
Pb 208 (mg/L)	5.109	-0.231	-0.787	2.096

■ Pb 208 (mg/L)

Figure 1. The Treatment of Hydroxyapatite (HAp) and Activated Carbon (AC) from Fish Bones in decreasing the content of Heavy Metal (a). Copper (Cu), (b). Zinc (Zn) (c). Iron (Fe) and (d). Lead (Pb).

Table 1.The analysis of Hydroxyapatite Treatment (HAp) and Activated Carbon (AC) from Fish Bones in decreasing the content of Heavy Metal: Copper (Cu), Zinc (Zn), Iron(Fe) and Lead (Pb).

No.	Treatment	Cu (Copper)		Zn (Zinc)		Fe (Iron)		Pb (Lead)	
		Rate	(%)	Rate	(%)	Rate	(%)	Rate	(%)
1	Treatment No	3.866		-327.032		319.528		5.109	
2	HAp of Fish Bones	0.458	88	-13.048	103	189.220	40	-0.231	95
3	AC of Fish Bones	-0.287	107	22.031	93	46.735	85	-0.787	84
4	(AC + HAp) of Fish Bones	1.591	58	-63.317	80	74.642	76	2.096	58

From Table 1 above, it is seen that Calcium and Activated Carbon from fish bones are effective in decreasing the rate of Lead (Pb) inside the water. It is proven by some parameters in filter media when water treatment was conducted.

Table 2. The Test Result of Fish Bone Nutrition Facts with 15 Parameters

No.	Parameter Test	Unit of Measure-ment	Result Fishbone Before Treatment	Result Fishbone After Treatment	LOR	Test Method References
1	Calories total	kcal/100g	558.66	1000.69	0.01	Calculation
2	Calories from fat	kcal/100g	<0.01	<0.01	0.01	Calculation
3	Fat total	g/100g	<0.01	<0.01	0.01	AOAC996.06
4	Carbohydrate	g/100g	26.99	57.85	0.01	Calculation
5	Protein	g/100g	6.37	1.92	0.01	AOAC920.152
6	Sugar total	g/100g	<0.01	<0.01	0.01	In-House based on AOAC 925.05
7	Dietary fiber total	g/100g	18.61	16.59	0.01	AOAC985.29
8	Saturated Fat	g/100g	<0.01	<0.01	0.01	In-House based on AOAC 996.06 & Operation Manual of Agilent Technologies
9	Trans Fatty Acid	g/100g	<0.01	<0.01	0.01	In-House based on AOAC 996.06 & Operation Manual of Agilent Technologies
10	Cholesterol	mg/100g	<0.01	<0.01	0.01	In-House Method based on Journal of Food Composition & Analysis 16 (2003)147-153
11	Vitamin AAS Retinol Acetate	g/100g	<0.01	<0.01	0.01	In-House based on AOAC 2002.06 by HPLC
12	Vitamin C	g/100g	0.51	0.06	0.01	In-House based on Report Analysis of water soluble vitamin by HPLC
13	Calcium (Ca)	g/100g	0.03	0.07	0.01	In-House method based on AOAC999.08
14	Iron (Fe)	g/100g	<0.01	<0.01	0.01	In-House method based on AOAC999.08
15	Sodium (Na)	mg/100g	2.68	3.21	0.01	In-House method based on AOAC999.08

Table 3. The Analysis of Test Result from the Fish Bone Nutrition Facts with 15 Parameters

No.	Parameter Test	Results Before Treatment	Results After Treatment	The Analysis Before and After Treatment		Notes
				Value of change	%	
1	Calories total	558.66	1000.69	442.03	$79.1 \approx 79$	Increase
2	Calories from fat	<0.01	<0.01	-	-	Stable
3	Fat total	<0.01	<0.01	-	-	Stable
4	Carbohydrate	26.99	57.85	30.86	$114.3 \approx 114$	Increase
5	Protein	6.37	1.92	4.45	$69.85 \approx 70$	Decrease
6	Sugar total	<0.01	<0.01	-	-	Stable
7	Dietary fiber total	18.61	16.59	2.02	$10.85 \approx 11$	Decrease
8	Saturated Fat	<0.01	<0.01	-	-	Stable
9	Trans Fatty Acid	<0.01	<0.01	-	-	Stable
10	Cholesterol	<0.01	<0.01	-	-	Stable
11	Vitamin	<0.01	<0.01	-		Stable
12	Vitamin C	0.51	0.06	0.45	$88.2 \approx 88$	Decrease
13	Calcium (Ca)	0.03	0.07	0.04	$133.3 \approx 133$	Increase
14	Iron (Fe)	<0.01	<0.01	-	-	Stable
15	Sodium (Na)	2.68	3.21	0.53	$19.7 \approx 20$	Increase

From the nutrition fact test result on the fish bone powder, there were 15 parameters used before and after the treatment, as indicated in table 2 and 3. It is found that the rate of four ingredients increase respectively by 79% for Calori, 114% for Carbohydrate, 133% for Calcium and 20% for Sodium. While three ingredients decrease in rate: 70% for Protein, 11% for Dietary Fibers and 88% for Vitamin C. On the other side, eight organic ingredients show stable rate: calori, fat calori, sugar, saturated fat, trans fatty acid, cholestherol, and AAS vitamin rethinyl acetate and iron.

Table 4. X-RF Test on Fish Bone Sample

No.	Compound	Count Unit (%)
1.	P	12.20
2.	S	0.59
3.	K	0.2
4.	Ca	85.41
5.	Mn	0.087
6.	Fe	0.19
7.	Cu	0.082
8.	Zn	0.17
9.	Sr	0.58
10.	Yb	0.45
11.	Re	0.07

It is seen from Table 4 and Figure 2 that X-RF test was conducted on fish bone sample and it is concluded that fish bones contain calcium with approximately 85.41 % count unit.
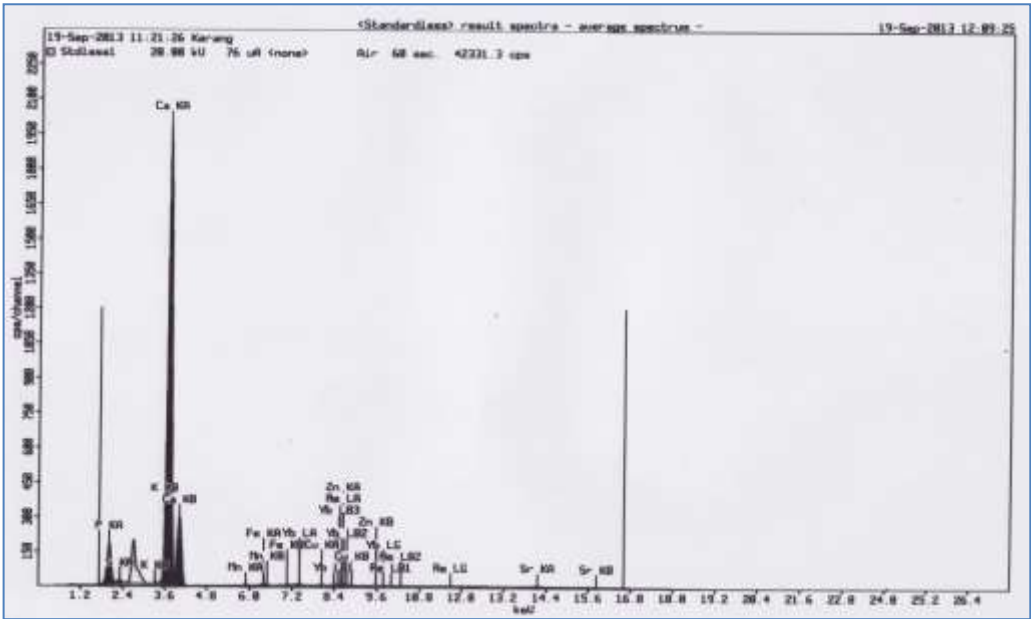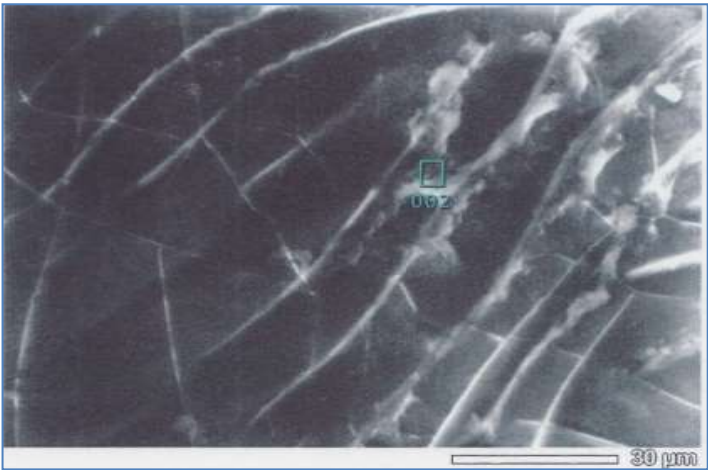
Figure 2. X-RF Chart of Fish Bone
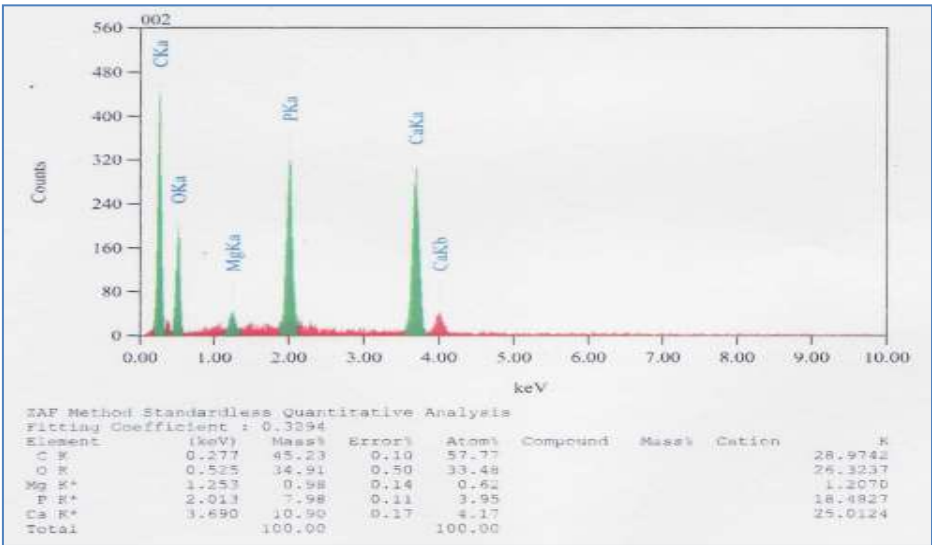

Figure 3. SEM Result of Fish Bones

Figure 4. EDS Result of Fish Bones at UPM Malaysia

Based on the SEM EDS test on the fish bones, it is concluded that there is calcium (Ca) contained in the spot Ca K+ 3,690 (keV) with mass percentage of 10.90 (%) and atom 4.17 (%), also on K position by 25.0124.

4   Conclusion

The transfer of knowledge and technology to people in coastal areas have resulted products made of the fish bone waste. The approach was done with social purpose, specifically for economic empowerment towards the pre-commercial and commercial process of the products (business oriented). Economically speaking, this program is able to realize a new industry with the use of good and organic materials. The calcium products, which are currently made of chemical materials, can be replaced by the organic calcium products made of fish bone waste. Through this program, the university hopes to empower the people in coastal community. Based on the quantitative data through characterization test, it is proven that the fish bones potentially contains high calcium, for which it is able to act as the water filter to clean the polluted water. Thus the water will meet the quality standard for drinking.

Acknowledgement

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