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by Khalil Khalil

Physical Characteristics and Mineral Composition of Bone Meals Produced from Different Body Parts of Cattle Bones by Open-Air Burning and Limed-Water Soaking

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Abstract

The study was aimed to measure physical characteristics and mineral composition of bone meal produced by simple processing methods from different body parts of inedible cow bones. Samples of inedible bones which were grouped into three body parts: head, arms, and rib were collected at three different meat processing companies: slaughter house, local meat shops and beef offal processor. The bones were then processed into bone ash and bone meal by open-air burning and limed-water soaking prior to grinding. Parameters measured included: percent of meal yield; content of crude ash, Ca and P; physical properties and particle size distribution. Results showed that meal yield of bone ash processed by open-air burning (67.3%) was found significantly lower ($P<0.01$) than bone meal produced by limed-water soaking (91.4%). However, mineral Ca (33.9%) and P (7.9%) content of bone ash were significantly higher ($P<0.05$) than that of bone meal (Ca: 26.7% and P: 1.8%). Particle size and distribution of particle size of bone ash and bone meal were found not significantly different. There was also no significant effect of different body parts of bones on meal yields, mineral composition and particle sizes. It was concluded that production of bone meal by open-air burning gave lower meal yield, but higher Ca and P concentrations than that of produced by limed-water soaking.

Keywords: *inedible bones, bone ash, bone meal*

Introduction

Calcium (Ca) and phosphorus (P) are two macro minerals that are normally taken into account in formulation of diet for livestock animals due to their various important functions in the body and metabolism. The province of West Sumatra abounds with Ca sources such as limestones and oyster shells (Khalil, 2003; Khalil and Anwar, 2007), but the use of these local minerals in the diets of chicken gave no significant positive effects on egg production, egg quality, growth rate and feed utilization efficiency presumably due to limited P concentration (Khalil, 2004; 2006; 2007; 2010; Khalil and Anwar, 2008). Proper utilization of Ca is affected not only by their sources and amount, but also by their ratio to P. The optimum Ca:P ratio is about 1.5-2:1 (Weaver and Heaney, 1999).

Bone meal is a potential source of P. Bone meal could locally produced from cattle bone as byproduct of slaughter houses that are available throughout the province areas. Bone meal contains Ca and P of about 31-39 and 14-19%, respectively (Kling and Woehlbier, 1983). The objectives of the present research were to measure physical characteristics and mineral composition of bone meal produced from different body parts of inedible cow bones by open-air burning and limed-water soaking processes.

Methodology

The study was initiated by taking samples of inedible bones at three different meat processing companies: slaughter house, local meat shops and beef offal processor in Payakumbuh city of West Sumatra. They were grouped into three body parts: head, arms and rib. Samples of fresh bones in each body part were divided into two groups and each group was subdivided into 3 sub-groups of about 2 kg each. Bones were then washed and boiled in a pressure cooker for about 4 h to free of fat, meat and other soft parts. The clean bones were the dried in the sun. The sun-dried samples were then crushed into chips with uniformly to the lengths of 2-3 cm. The first groups were intended to open-air burning. They were burned on a metal plate, cooled and then ground into meal form.

The second part of samples were soaked in 10% lime water for 5 days, and then dried in oven at 60◦C for 48 h. The dried bones were then ground into meal form. The meals were chemically analyzed for crude ash, DM, Ca, and P content (AAS, 1980). Physical properties measured included bulk density, angle of responses and particle sizes. Data were statistically analyzed in completely factorial design of 2x3x3. There were 2 processing methods, 3 different body parts and 3 replications (Steel *et al*., 1997).

Results and Discussion

Data on meal yield rate, mineral composition and physical properties of bone meal produced from different body parts of inedible bones by open-air burning and lime-water soaking are presented in Table 1. Rate of meal yield ranged from 64.5 to 91.9%. The average meal yield of bone ash produced by open-air burning (67.3%) was found significantly lower (P<0.01) than bone meal produced by limed-water soaking (91.4%). There was no significant effect of different body parts of bones on the rate of meal yields.

Table 1. Rate of meal yields, mineral composition and physical properties of bone ash and bone meal produced from different body parts of inedible bones

Parameter	Bone ash				Bone meal			
	Head	Arms	Rib	**Mean**	Head	Arms	Rib	**Mean**
Rate of meal yield, %	71.72^{b}	64.55^{b}	65.51^{b}	**67.26^{B}**	91.88^{a}	92.14^{a}	90.31^{a}	**91.44^{A}**
	(0.61)	*(0.73)*	*(0.76)*	***(0.65)***	*(0.79)*	*(1.52)*	*(1.33)*	***(1.18)***
Crude ash and mineral composition, % DM:								
- Crude ash	87.05^{a}	85.76^{a}	84.72^{a}	**85.85^{A}**	72.69^{b}	64.37^{b}	62.07^{b}	**66.38^{B}**
	(0.65)	(1.36)	(0.95)	**(0.47)**	(1.09)	(0.96)	(2.96)	**(1.01)**
- Ca	32.43^{a}	34.71^{a}	34.43^{a}	**33.86^{A}**	29.27^{b}	27.95^{b}	27.95^{b}	**26.68**
	(2.47)	*(0.34)*	*(0.09)*	***(0.77)***	*(0.49)*	*(1.33)*	*(1.33)*	***(1.37)***
- P	7.75^{a}	8.06^{a}	7.86^{a}	**7.89^{A}**	0.43^{c}	4.52^{b}	0.36^{c}	**1.77^{B}**
	(0.52)	*(0.17)*	*(0.09)*	***(0.23)***	*(0.12)*	*(0.43)*	*(0.13)*	***(0.19)***
Physical properties:								
- Bulk density, g/ml	0.94	0.85	0.88	**0.89**	0.99	0.75	0.84	**0.86**
	(0.01)	*(0.02)*	*(0.01)*	***(0.01)***	*(0.00)*	*(0.01)*	*(0.01)*	***(0.00)***
- Angle of response, ^{o}	49.94^{a}	50.48^{a}	51.14^{a}	**50.52^{A}**	43.46^{b}	44.83^{b}	45.31^{b}	**44.53^{B}**
	(0.41)	*(0.35)*	*(0.22)*	***(0.23)***	*(0.79)*	*(0.17)*	(0.66)	***(0.12)***

[1] (SEM): standard error of the mean;
[2] [abc] Means within same row with different superscripts are significantly different (P < 0.05)

Bone ash processed by open-air burning showed significantly higher content of crude ash (85.8%), Ca (33.9%) and P (7.9%) than bone meal by limed-water soaking (ash:66.4%; Ca: 26.7%; P:1.8%). The average P content of bone meal from (1.8%) was much lower than bone ash produced by open-air burning (7.9%). The P content of bone meal produced from arm bones (4.5%) was significantly higher than that of other body parts (0.36 and 0.43%). The average P content of bone ash (7.9%) and bone meal (1.8%) in the present study was much lower in compare to that reported by Kling and Woehlbier (1983) of 14 and 19%, respectively.

Bulk density of bone meals ranged from 0.75-0.99 g/ml and there was no statistically different in bulk density. Bone meal produced by limed-water soaking showed significantly ($P<0.05$) lower angle of response (44.5°) in compare to meal produced by open-air burning (50.5°). Bone meal produced by lime-water soaking tended to have higher particle size, so that the particles in this product were more mobile than the bone meal produced by open-air burning.

Conclusion

It was concluded that production of bone meal by open-air burning gave lower meal yield, but higher Ca and P concentrations than that of produced by limed-water soaking prior to grinding. Bone ash was better source of P in compare to bone meal.

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