SUPPORTING PAPERS
ISBN 979-97243-9-2

PHYSICAL COMPARATIVE AND NUTRITIVE CHARACTERISTICS OF MALEO EGGS

Hafsah[1] Rudiah[1], Tri-Yuwanta[2] and Kustono[2]
[1] Animal Science Department, Agriculture Faculty ,Tadulako University, Palu
[2] Animal Science Faculty, Gadjah Mada University, Yogyakarta

ABSTRACT

Maleo bird (*Macrocephalon maleo,*S.Muller), is endemic bird of Sulawesi that lays its eggs in tropical rainforest closed to geothermal sources or at beaches exposed to the sun. This bird is severely threatened by over-exploitation of its eggs and destruction of its nesting grounds and habitat. It is listed in the Red Data Book and has been the subject of conservation projects supervised by the International Council for Birds Preservation (ICBP), World Wide Fund for nature (WWF), and the Indonesian Department of Nature Conservation (PHPA). The eggs that used in this experiment take from the nature habitat (nesting ground) at Lore lindu National Park, that selected (unused) for hatchery because it has spotted in that egg shell. Physical characteristics that measure are: egg weight, egg shell weight, egg shell thickness, egg index, egg shape, yolk, albumen. Fresh eggs were weighed to the electric ohause balance with 400g the scale 0.01. Length and width of egg were measured by used vernier caliper, egg shell thickness by micrometer, yolk color by yolk color fan, and Hough unit (HU). The egg shape eggs are expressed as length divided by width (L/W), the relative yolk content is expressed as a percentage of the egg content weight. The size of maleo eggs is five times of chickens eggs (maleo egg: 250 g and chickens is 50 g) .The physical characteristics and nutritive composition of maleo eggs have been identified their suitability for table consumption and specific characteristics. Some comparisons were made between maleo eggs and those of avian species. Physical characteristics have been identified: eggs weight (220g), eggs shell thickness (0.39mm), yolk color (14-15), yolk (67.84%, albumen (24.17%), HU (67.41), shell color (brown), eggs index (72.42%). Nutritive composition of maleo egg are: water (69.93%), crude protein (16.26%), fat (39.22%), crude fiber (0.40%), ash (3.46%), cholesterol (405.77mg/100g), Ca (108.33mg), P (248.43mg), vitamin A (664.53 IU/100g), vitamin B1 (1.37mg), gross energy (7033 kcal). Whereas amino acids and fatty acids composition are not significantly different compared to that of other avian species. The specifics characteristics of maleo eggs compared to other eggs of avian species in: size, yolk (color and weight), cholesterol and calcium content extremely different with others avian eggs.

Keywords: Maleo birds, Eggs, Conservation, Physical and chemical characteristics

INTRODUCTION

Maleo bird (*Macrocephalon maleo,*S.Muller), the endemic bird of Sulawesi is a megapode that lays its eggs in the nests communally on solar-heated beaches and geothermal heated forest soil. It is vulnerable to extinction mainly because of over-collection of eggs by human. This bird is severely threatened by over-exploitation of its

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eggs and destruction of its nesting grounds. It is listed in the Red Data Book by IUCN (International Union for Conservation of Nature) in 1966 as *endangered species* and has been the subject of conservation projects supervised by the International Council for Birds Preservation (ICBP), World Wide Fund for nature (WWF), and the Indonesian Department of Nature Conservation (PHPA).

MacKinnon (1981) and Watling (1983) reported that recent declined in maleo population caused not only by over exploitation of the eggs but also by destruction of the habitat. The human population on Sulawesi has increased sharply, both from the high birth rate and as a result of transmigration of people from the over populated islands of Java and Bali. New villages have been established and roads have been built, especially along the coastal area. Wallace expedition in 2005 was reported that population estimation of maleo birds in Sulawesi approximately 1000 pairs.

Eggs laying season of that birds differently between coastal area and geothermal forest area, for instance in Suaka Margasatwa Tanjung Matop (coastal area) has laying season in April-September for each year, and in Lore Lindu National Park (Geothermal forest area) laying egg during the year but the peak eggs production in June-July (Hafsah, *et.al.*2005). Avian eggs provide a well balanced source of nutrients for people of all ages (Cook and Briggs, 1977). An egg is of good quality when the characteristics are such that it is preferred by the consumer, whether the preferences are rational or irrational. The concept of egg quality today embraces both the external and internal characteristics of the egg (Belyavin *et al.*1987).

Megapode eggs are heavy in relation to body size, and rich in yolk (Seymour, 1985). A large yolk content in bird eggs is related to the stage of development of the young at hatching. These characteristics are directly related to their aberrant breeding strategies. Megapodes do not incubate their eggs with body heat but bury them directly in the ground in burrows, where heat comes from volcanic activity or the sun. That bird hatchling, which do not get any parental care and are able to fly on the day of hatching (Dekker, 1990).

Maleo eggs are used for human consumption in small scale in certain areas that nesting ground closed to habitat at Sulawesi Island. This paper reported the physical characteristics and chemical composition of maleo eggs from experimental research, and attempt to assess the acceptability of maleo eggs as a nutritive human food.

MATERIALS AND METHODS

The eggs that used in this experiment take from the nature habitat (nesting ground) at Lore lindu National Park, that selected (unused) for hatchery because it has spotted in that egg shell. Physical characteristics that measure are: egg weight, egg shell weight, egg shell thickness, egg index, egg shape, yolk, albumen. Fresh eggs were weighed by electric ohause balance with 400g the scale 0.01. Length and width of egg were measured by used vernier caliper, egg shell thickness by micrometer, yolk color by yolk color fan, and Hough unit (HU). The egg shape eggs are expressed as length divided by width (L/W), the relative yolk content is expressed as a percentage of the egg content weight. Chemical composition of that egg were analyzed i.e. proximate analyze (water, crude protein, fat), mineral, vitamin, cholesterol, amino acid, and fatty acid.

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RESULT AND DISCUSSION

Physical characteristics

Physics Characteristics of maleo eggs compared with chicken eggs were shown in Table 1.

Table 1. Comparative physical characteristics of maleo and chicken eggs

Components	Maleo eggs*	Chicken eggs*
Weight (g)	220.50	68.03
Length (cm)	13.27	8.37
Width (cm)	9.68	7.27
Yolk color	14 – 15	8
Shell thickness (mm)	0.39	0.38
Egg shell (%)	7.80	9.16
Yolk (%)	67.84	35.57
Albumen (%)	24.17	55.02
HU	67.41	58.90
Shell color	brown	brown
Egg shape	Oval	Oval
Egg index (%)	72.42	86.85
Egg shape	1.40	1.20

* Mean of three replicates

Egg weight of maleo was shown 3-4 times of the chicken egg weight, egg composition of yolk (67.84%) and albumen (24.17%), whereas in that chicken egg yolk (35.57%) and albumen (55.02%). Yolk color based on measuring by using yolk color fan become orange with the index 14-15, and in chicken egg yolk just 8-9. Compared in body weight, egg weight represented 14.7% of the body weight of the maleo, whereas for chickens 3.5% (Panda, *et al.* 1979), 1.2% for ostrich (Sales, *et al.*1996), 1.0% for turkeys (Bitman and Wood, 1980), and 8% for quails (Panda and Singh, 1990).

The shape of egg from this study represented 1.40 more lowest than compared with maleo eggs from Tambun (1.70) and Tumokang (1.73) in North Sulawesi (Dekker, 1990). The higher the shape (L/W) ratio, the more elongated of the egg. Compared to another avian species i.e. Wattled Brush-turkey *Talegalla jobiensis* 1.55 (Harrison and Frith, 1970), 1.58 for Nicobar Scrub fowl, 1. 65 for Micronesian Scrub fowl, 1.67 for Polynesian Scrub fowl (Dekker, 1990).

The external appearance of an egg is influenced by many factors, e.g. breed, genetics, species, age of female, egg storage condition and length of storage time, season of the year, habitat and diet of the layer (Powrie, 1977).

The external physical characteristics of maleo eggs differ greatly from those of avian species, especially the size of yolk. The amount of yolk as a proportion of the maleo eggs in this study (67.84% of the total egg weight), compared to Australian Brush-turkey, and Malleefowl that reported by Vleck *at al* (1984) 50.1% with the range: 48-52%, and 52.6% with the range: 51-54%) respectively. In eggs of palaeognathous birds the yolk ranges from at least 32-38% of the egg contents weight in *Struthio,* 40-42% in *Casuarius*, 61-69% in *Apteryx* (Carey et al.1980) For anseriforms, yolk content ranges 48-55%,and galliforms except megapodes 32-49%, in megapode ranges from 48-

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55%, it is especially in *macrocepahlon* 61-64%, *Megapodius* spp. 65-69% (Sutherland and Rahn, 1987)

Nutritionally, yolk is important because it yields 75% of the calories and provides all or most of the fat, iron, vitamin A, thiamine, and calcium of an egg. Almost half of the protein and riboflavin content of the whole are found in the yolk (Cook and Brigs, 1977). In addition, Hartmann and M. Wilhemson. (2001) described the yolk and albumen dominantly influenced by breed and age of the animal.

The high xanthophylls and carotenoid caused the color of yolk become red orange. Thickness and egg shell of maleo egg (0,39 mm, 7,8%) which is similar to the chicken(0,38 mm, 9,16%) and for duck (0,37 mm, 10,58%), that influenced by mineral contents of the diets (Keshavarz, K. 1985).

Nutritive characteristics

The proximate composition of the whole egg is presented in Table 2. The eggs of maleo contain high fat and protein (39.22%, 16.26%) compared from other avian species i.e. chicken, duck, turkey, ostrich, and quail. That maybe influenced by the habitat of that birds especially the feed stuff are consumed highs in fat. Rudiah *et al* (2005) reported that the fat content was consumed of the maleo bird 20.74%, protein (17.45%), and crude fiber (11.43%). The high fat, cholesterol, mineral, and vitamin A content of maleo egg, probably because of the greater heat requirement of the developing embryo, maleo chick in one day old has plumage completely not like in chicken. One day old of maleo chick can be flight directly to another place.

A result of determination of fatty acid and amino acid was representing in Table 3. Regarding of the fatty acids content of maleo egg, appear to have a higher content of oleate (C18:1) Ω-9 and palmitate (C16:0). The total quantity of amino acids are determined in maleo egg have a higher content of lysine and valine compared to chiken egg, the composition of amino acid especially in lysine, triptophan, valine, histidine, and arginine slightly high in maleo egg.

Table 2. Comparative nutritive characteristics of maleo and chicken eggs

Components	Maleo eggs*	Chicken eggs**
Water, %	69.93	65.60
Protein , %	16.26	12.10
Fat, %	39.22	11.50
Crude fiber, %	0.40	-
Ash %	3.46	3.17
Cholesterol, mg/100g	405.77	226
Calcium, mg / 100g	108.33	0.114
Phosphor, mg / 100 g	248.43	0.59
Vitamin A, IU/ 100g	664.53	500
Vitamin B1, mg / 100g	1.37	0.2
Energy	7033 (GE,kcal)	165 (cal/100g)

* Mean of three replicates
** Romanoff and Romanoff, 1963.

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Table 3. Fatty acids and amino acids composition of maleo eggs

Fatty acids*		Amino acids*	
Components	%	Components	%
Miristat (C14:0)	4,90	Lysine	43,73
Palmitat (C16:0)	19,54	Methionine	12,05
Palmitoleat (C16:1)	1,31	Triptopan	19,53
Stearat (C18:0)	9,27	Leusine	28,26
Oleat (C18:1) Ω-9	25,82	Valin	43,64
Linoleat (C18:4) Ω-6	3,65	Histidin	32,73
Linolenat (C18:3) Ω-3	0,66	Phenilalanine	17,04
Arachidonat (C20:0)	0,38	Threonin	10,39
		Arginin	23,31

CONCLUSION

From this information can be concluded that the physical and nutritive characteristics of maleo eggs more slightly different with chicken egg or another aves species, especially on the egg size and egg yolk content. Maleo egg yolk presented more high three times from albumen. Possibility of maleo egg can be regarded as an acceptable nutritive product for human consumption as far as available. The fresh maleo egg which available may be marketed as an exotic product.

ACKNOWLEDGEMENT

This study was supported by High Education Project "Hibah Pekerti Research" Joining research between Tadulako University and Animal Science Faculty Gadjah Mada University, period of year : 2004-2005.

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