NUTRIENT COMPOSITION AND VALUE OF SELECTED GAME MEAT: A REVIEW

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ABSTRACT
Now days people consider game meat to be healthier and safe products, and therefore associate to healthier and tasty meat arising from game animals. Because of this an overview is presented on the global human usage of unconventional animal species (ungulates, lagomorphs, other landed wild mammals and birds) that are hunted for human consumptions. The nutritional values of these species is discussed, focusing on their potentials for food security**.** One of the most valuable foods is meat, due to its nutritional value, largely determined by the essential amino acids, fatty acids, vitamins, minerals, etc. The importance of wildlife to local communities is now globally recognized in community-based. The results presented in this review are mostly on the proximate and biochemical composition of some selected species of game animals. Warthog and domestic pig meat was compared**,** where warthog presented a higher (74.04,1.69, 22.14 and 1.29, for moisture, total lipids, proteins and ash respectively) values (Table 2). Likewise, macro and micronutrient in domestic pigs and wild boars was also reviewed (Tables 8&9). The results showed that K and Ca values (11239.00[a] and 208[a]) in wild boars was significantly (P<0.05)higher than in domestic pigs. Micronutrient in wild boars shows significant (P<0.05) differences, with levels of Fe, Zn and Cu higher (136, 91 and 90.3% respectively) above that of domestic pigs. Chemical composition of Hartebeest was also compared in different regions and among sex (Table 3), where values for nutrient compositions did not differ except ash content for sex, where females exhibit higher (1,3±0.18) value than in males(1.2±0.20).Chemical compositions in ostrich was found to be higher than in beef and chicken particularly for fat content (0.90-1.34%)(Table 10).It was also observed among all the animals species studied that cholesterol levels ranges between 64.41-95.01 mg/100g in both fat and muscles (Table 13).The review therefore highlights not only the economic importance of wildlife, through consumptive and non-consumptive uses, but also present the potentials of nutritional value.
Key Words; Nutrients, composition, Game, meat,

Introduction
In a global sense, game refers to wild animal and birds, with the term game being used for culinary purpose to describe all birds and animals that are hunted for food (Costa *at al.,* 2016). In the European union (EU), wild game is defined as being, wild ungulates and lagomorphs, as well as other land mammals that are hunted for human consumption and are considered to be wild game under the applicable law in the member state concerned. These includes mammals living in enclosed territory under conditions of freedom similar to those of wild game and wild birds that are hunted for human consumption, (Costa *et al*., 2016). Around the world, a vast number of wild animals are harvested for several reasons, including for food purpose and sport hunting, with the type and range of animals hunted, depending on climate, animal diversity, tradition, local taste, legislations and local perception on what can or cannot be legitimately hunted. Red meat is an important source of minerals (mainly Zn, Fe, and Mn) in human diet, as provides highly bioavailable elements required for normal development and health (Nikolic *et al*., 2015), Tomovic *et al.,* 2015). Macro and micro nutrients, serve many functions in the human organism. They are the building material of bones, teeth, skin and hair and are fundamental components for metabolic processes, maintenance of acid base equilibrium and regulation of water and electrolyte metabolism (Soetan *et al*., 2010; Ustymowicz-Farbiszewska *et al*., 2014).
According to Onyongo *et al*. (1998), the decrease in the per capita supply of high quality protein and the increase in the world's population have intensified the need to search for other sources of protein. Although there is an increase in the demand for game, and tendency for the meat to be sold under the generic name of game meat or venison with no specific indication of species. Therefore, the objectives of the review is to present the analyzed data on the nutrient composition and food values of must wild animals which may not be readily available for use by institutions and individual needs

particularly in the health institutions and to give an insight on the comparative analysis of selected elements in some carcass parts of wild or game meat.

Chemical composition of meat and nutritional considerations

Now days, consumers are increasingly demanding for healthy and safe products as they are concerned about the food they eat. In general, consumers associate game to a healthier, thinner, and tasty meat arising from animal that supposed to be free of hormones and generally be considered to be highly nutritious (Costa *et al*., 2016).

Table1: Proximate composition of meats from different game species (g/100g; mean values are given).

Animal species		**Proximate composition(g/100g)**			
		Moisture	**protein**	**Fat**	**Ash**
Ungulates					
Kudu	*Tragelaphus strepsiceros*	74.14-74.49	23.60-24.30	1.56-1,58	1.23-1.29
Impala	*Aepyceros melampus*	70.2-74.0	18.9-20.0	1.2-4.3	4.4-4.6
Springbok	*Antidorcas marsupialis*	70.4-75.3	17.4-18.4	2.5-5.3	4.2-4.3
Blesbok	*Damaliscus dorcas phillipsi*	68.20-75.33	19.30-22.43	0.21-6.8	1.24-4.2
Com. duiker	*Sylvicapra grimmia*	71.41	25.71	2.12	1.29
Red deer	*Cervus elaphus*	76.90	21.70	0.60	1.11
Fallow deer	*Dama dama*	74.90	22.0	2.50	1.08
Roe deer	*Capreolus capreolus*	68.20	22.82-25.35	1.0-2.12	1.29
Elk	*Alces akces*	---	22.72	1.33	--
Mouflon	*Ovis ammon*	74.52-75.30	21.88-22.35	0.61-0.99	1.03-1.12
Wild boar	*Sus scrofa*	72.8-75.0	21.4-23.23.6	1.1-4.4	--
Leporidae					
Wild rabbit	*Oryctolagus cuniculus*	74.86	23.71	0.20	1.18
Hare	*Lepus europaeus*	72.83	24.7	1.48	--
Game birds					
Wild duck	*Anas platyrhynchos*	73.95-74.9	19.6	3.39	1.27
Quail	*Coturnix japani*	73.60-73.65	22.94-22.96	2.31-3.32	1.56-1,57
Pheasant	*Phasianus colchicus*	73.09-75.14	22.22-25.37	0.13-0.40	1.26-1.35
Pigeon	*Columbia livia*	66.52-70.59	20.56-23.61	0.98-1.48	0.98-1.48

Source: Costa *et al*. (2016)

Table I shows a results on the proximate Composition of different game meat. The values presented shows that evaluated animal proteins content are generally higher than 20% with some species presenting levels around 25% protein. On the contrary, total fat content can be considered as being low, as it is generally inferior to 5%, with some species including different ungulates, lagomorphs, and game birds presenting levels less than 0.5% fat. Currently it is a general agreement that total fat intake is certainly related to health risks, however it is also accepted that both quantities and qualitative aspects are important. Thus the type of consumed fat or fatty acids is of critical importance.

Table 2: Mean mineral concentration per 100g of edible raw tissue of Reindeer meat

Element	Mean ±SD					
	Meat (n=29)	Liver (n=29)	Tallow (n=15)	Bone marrow (n=9)	RDA Male	Female
Zn(mg)	6.8±0.2	3.5±1.7	0.2±1.0*	0.1±0.1*	7mg	9mg
Ca(mg)	5.4±10	6.4±1.1	5.1±2.1	339.7±277.3*	1g	1g
Fe(mg)	3.3±0.7	41.1±21.7	4.1±1.5	3.1±1.30	16mg	9mg
Se(mg)	3.0±3.2	48.7±48.9	0.8±1.6	0.2±0.5	40mg	50mg

Source: Ammar *et al*. (2012)

Mean mineral concentrations (mg/100g) of edible raw tissue for Ca, Fe and Zn was reported by Ammar *et al*. (2012**)** (Table 2). The highest concentration of 339.70±277.30mg/100g was found in bone marrow (P<0.01). The Ca concentration in meat and tallow were higher (5.40±1.0 iron and 5. 10±2.10mg/100g), when compared to iron of 3.3±0.7 and 4.1±1.5mg/100g respectively). Liver appeared to be the best source of Fe in terms of mean concentration at 41.10+±21.70 mg/100g (P<0.01). There were no differences in Fe concentration of meat, tallow and bone marrow (P>0.05), with the following concentration 3.3± 0.70, 4.10±1.50 and 3.1±1. 30mg/100g. Liver also had the highest Se content of 48.70±48.90mg/100g(p<0.01). The Se concentrations in meat, liver, tallow and bone marrow (Table 2) were characterized by variations among districts and from animals within the same districts (result not shown), with one animal demonstrating a remarkable high Se concentration (data not show). These variations have resulted in standard deviations similar or higher than the mean concentration. The Zn in liver was the only mineral that was significantly correlated with meat (r= 0.77, P<0.01). As expected the result from Table 2 revealed considerable differences in nutrient levels between the meat and the rest of the studied tissues. These differences were statistically significant (P<0.05), except for Se and Fe in tallow and bone marrow.

Table 3: Biochemical Composition of Game Meat

Group	N	Protein%	Fat%	Cholesterol(Mg100g-1)
Elk	8	22.72	1.33	64.41
Deer	18	22.36	1.90	70.57
Roe deer	16	22.82	1.59	67.92
Wild boar	12	22.92	2.82	95.07
Beef	15	19.61	1.48	76.31
Pork	15	21.32	2.77	57.85

Source: Vita *et al*. (2013)

Cholesterol found in muscles is free cholesterol and it is not related to that in animal blood, i.e. "good" or "bad" cholesterol. It is found in both fat and muscle in the range 64.41 to 95.07 mg 100 g-1 among animal species (Table 3). From a nutritional point of view, in terms of cholesterol, none of ruminant meats is superior (preferred) over others. The exception is wild boar meat, in which higher cholesterol levels can be explained by the high level of adrenaline under stress during the hunting season. The cholesterol levels statistically differed between animals ($F = 2.55$, $P < 0.05$) (Vita *et al*. ,2013). The human body requires the essential amino acids lysine, isoleucine, phenylalanine, tryptophan, leucine, methionine, threonine, and valine. Each of these amino acids have a role in the human body. Game muscle protein contains all essential necessary amino acids. Wild deer, roe deer and elk meat samples are similar in the summed concentrations of essential amino acids. Wild boar and pork samples, differed most in the summed concentrations of essential amino acids: 24.14 and 12.35 g 100 g-1, indicating the relatively higher biological protein value of wild boar over pork (Vita *et al*.,2013).

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