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PRODUCTION POTENTIALS AND THE PHYSICOCHEMICAL COMPOSITION OF SELECTED DUCK STRAINS: A MINI REVIEW

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ABSTRACT: Physicochemical composition of meat is an important factor in human nutrition and contributes to the choice of food by mankind. In recent times humans are much conscious of the health benefits of what they consume. Emphasize on the consumption of balance diets have been given much attention. The consumption of organic foods, vegetables, fruits, foods high in fibre, foods of animal origin with less fat and cholesterol are among the food stuffs being upheld. Poultry meat, eggs and products are widely consumed worldwide without much religious restrictions. The high consumption of poultry meat is partly due to it ease for preparing different dishes and the development of a wide range of processed ready-to-eat meals incorporated with chicken as a major protein source. Poultry meat (white meat) is known to be healthier than red meat probably due to its low calorie and lipid contents. Duck meat is comparable to that of chicken despite being red meat and it is a close alternative source of protein and other nutrients for humans. Duck meat is high in protein, iron, selenium and niacin; and lower in calories compared to many cuts of beef. This mini-review reports on the production potentials of ducks and the physicochemical composition of selected duck strains. It also reports on world duck population.

REVIEW ARTICLE

Key words: *Duck meat, consumption, health benefits, nutrition, physicochemical*

INTRODUCTION

Physicochemical composition of meat comprises of both the physical and chemical properties of meat. Physical components include slaughter weight, meat colour, water content and so on while the chemical (nutrient) composition protein content, lipid content and many more. Humans are becoming increasing concern about food safety issues. Such issues include how safe a particular food substance is in terms of it microbial status, the presence of certain chemicals, compounds or nutrients in foods which are indigestible and thus may leave permanent residual effects and the nutrient composition of foodstuffs. Proteins, carbohydrates, lipids, vitamins, minerals and/or water are important nutrients which when combined in the right proportion promote healthy life. Proteins can be derived from both animal and plant sources. Although animal protein is closely related to that of human protein and the fact that some plant proteins lack certain essential amino acids, animal protein has undergone some criticism due to it association with cancer, heart diseases and/or other unknown complications (Brown, 2003; Danaei et al., 2009; Jakobsen et al., 2009; Tanaka, 2012). More so, protein from white meat (poultry, rabbit) is more preferred to protein from red meat (duck, beef, chevon, mutton) sources due to it less fat and cholesterol content (Brown, 2003; Tanaka, 2012).

Poultry meat is largely consumed worldwide. It is easy to prepare and has been used for developing several ready to eat and processed food products. A close relation that can serve as an alternative to poultry meat is duck meat. The nutrient composition of duck meat and eggs are comparable to that of chicken (Tai and Tai, 2001, Adzitey et al., 2012). Duck meat is high in protein, iron, selenium and niacin; and lower in calories compared to many cuts of beef (Anonymous, 2010). Duck meat, like that of chicken can also be used for the preparation of several processed meat products. It has been used to prepare sausages, meatballs, and many more (Huda et al., 2010; Huda et al., 2011; Putra et al., 2011). Duck meat and products are relished and consumed by many, especially people from the Far East (Tai and Tai, 2001). Ducks have the advantage over chickens in that; they are hardy and have better adaptation to harsh environmental conditions (Adzitey and Adzitey, 2011; Adzitey et al.,

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2011). Ducks have also undergone breeding and selection to improve upon their performance and characteristics. The meat quality and physiochemical characteristics of duck breeds are also under intensive under research for improvement.

Despite this a review on the production potentials of ducks, the nutrient composition of duck meats, and world duck production is unavailable. Thus, this paper presents a short summary of the production potentials of ducks and the physicochemical composition of selected duck strains. It further gives a summary of world duck production.

PRODUCTION POTENTIALS AND PHYSICOCHEMICAL (NUTRITIONAL AND PHYSICAL) ATTRIBUTES OF DUCKS

Intensive breeding and selection of ducks have resulted in the production of duck breeds and strains with desirable traits and growth performance. Different genotypes of ducks including common ducks such as Pekin ducks (*Anas platyrhynchos*), Muscovy ducks (*Cairina moschata*), mule ducks (crossbreed) and hinny ducks (crossbreed) are widely used to produce meat. Zhou (2011) reported that the modern domestic White Pekin duck currently outpaces the modern broiler chicken in terms of body weight gain and feed efficiency to the same live weight due to genetic improvement. Ducks from the paternal pedigree strain A44 for example, have been selected in order to increase their musculature and decrease fatness (Wawro et al., 2004). Optimum slaughter weight for broiler ducks has been reduced to 7 or 8 weeks through selection (Adamski et al., 2005; Kokoszynski and Korytkowska, 2005). The natural ability of ducks to grow rapidly in free range, scavenge on their own and resist a number of diseases as well as control insects can be relied on in selection and breeding programs to reduce input cost while improving carcass quality. It has been noted that the more sophisticated duck strains may perform better in modern intensive production systems that provide adequate shelter, requisite nutrition to optimize growth rate and standard health programs (Zhou, 2011).

Potentially, a variety of duck breeds (Pekin, Muscovy, Khaki Campbell and mule) are available for production, feed stuffs (conventional, non-convention and by-products) are also readily available, and duck meat and products have good market especially in Asian countries. The meat has several potentials for developing processed meat products. These potentials have been described in details by Huda et al. (2011). With recommendations for the reduction of red meat intake due to its association with cardiovascular pathologies, the consumption of white meats and duck meat is gaining more attention (Pfeuffer, 2000; Witak, 2008). Anonymous (2010) reported that duckling breast without skin is lower in calories (140 cal vs165 cal), lower in fat (2.5g vs. 4g), and richer in iron (5mg vs. 1mg) compared to chicken breast without skin and of good value to individuals interested in weight loss or management. Dry-cured duck breast has low moisture and high protein content in comparison with other dry-cured meat products made from cuts of whole meat (Lorenzo et al., 2011). Lysine and leucine, followed by valine, threonine and isoleucine are the main essential acids present in dry-cured duck meat (Lorenzo et al., 2011). Aspartic and glutamic acids were the most important nonessential amino acid fraction found (Lorenzo et al., 2011). Lorenzo et al. (2011) also reported that the dry cured-duck breast also proved to be a valuable source of iron, zinc, copper and manganese.

Research has also been carried out (and are still being carried out) with specific focus on the improvement of dressing percentage (Kokoszynski and Korytkowska, 2005), chemical composition of muscles (Adamski, 2005), and physical and chemical meat characteristics (pH, water holding capacity and colour) (Adamski et al., 2005) of ducks. Important meat quality traits such as the amino acids (essential and non-essential) and fatty acids (unsaturated-mono and polyunsaturated, and saturated) composition of duck meat are also under studies and improvement (Woloszyn et al., 2006). The physiochemical characteristics, fatty acid and amino acid composition of some duck strains have been summarized in Table 1. The values are averages of both male and female ducks slaughtered at 7 weeks of age. Duck strain A4 (3.143kg) had the highest pre-slaughter weight compared to Star63 (2.997kg), PP54 (2.645kg) and CaA15 (2.488kg) but exhibited the lowest dressing percentage of 60.70%. Star63 (69.85%) had the highest dressing percentage, followed by CaA15 (69.45%) and PP54 (68.90%). The high pre-slaughter weight of A4 had a positive influence on the breast and thigh muscles by being heavier than the other strains. The pH range among all the duck strains were within acceptable limits and thus the meats were not pale soft exudative. Postmortem pH decline influences the ability of meat to retain moisture (Huff-Lonergan and Lonergan, 2005; Adzitey, 2011). The water holding capacity, crude protein and fat contents, and meat colour of A4 were also within acceptable limits.

The percentage protein of P66 (21.81%) was the highest, followed by P55 (21.37%), K2 (20.91%), P33 (20.25%) and A3 (19.53%). In humans protein is important for growth, maintenance and repair of won out tissues (Lloyd, 2011; Tanaka, 2012). It can also serve as a source of energy in the absence of carbohydrate (Lloyd, 2011). From Table 1, ducks are important source of amino acids such as leucine, lysine, threonine, tryptophan and valine. The amino acid composition was highest for P55 except tryptophan which was highest in A3. The amino acid composition of P66 was close to that of A3 and was better than the other strains. The percentage lipids were 1.32%, 1.32% 1.28%, 1.16% and 0.80% for A55, P66, A3, K2 and P33, respectively. Lipids are very important source of energy for humans but it excess have adverse effect on health. The cholesterol level was least in A55 and highest in K5. Cholesterol is important for the production of hormones, for normal functioning of the brain, nerve tissues and cell membrane, synthesis of Vitamin D and many more (Anonymous, 2011).

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Table 1 - Physiochemical characteristics, fatty acid and amino acid composition of some selected duck strains

Parameter/Strain	A4	P33	K2	A3	A55	P66	Star 63	PP54	CaA15
Preslaughter body wgt (g)	3143	-	-	-	-	-	2997	2644.5	2488
Eviscerated carcass wgt (g)	1907	-	-	-	-	-	-	-	-
Dressing % (%)	60.70	-	-	-	-	-	69.85	68.90	69.45
Breast muscle (%)	14.40	-	-	-	-	-	14.00	13.40	13.50
Leg muscle content (%)	15.20	-	-	-	-	-	13.55	11.65	13.70
pH_{15}	6.23	-	-	-	-	-	5.85	6.015	5.865
pH_{24}	5.76	-	-	-	-	-	5.43	5.44	5.485
Water holding capacity (%)	17.50	-	-	-	-	-	-	-	-
Meat colour (L)	33.20	-	-	-	-	-	-	-	-
Water content	77.10	-	-	-	-	-	-	-	-
Crude protein content	19.4	-	-	-	-	-	-	-	-
Crude fat content	3.60	-	-	-	-	-	-	-	-
Protein (%)	-	20.25	20.91	19.53	21.37	21.81	-	-	-
Lipids (%)	-	0.80	1.16	1.28	1.32	1.32	-	-	-
Moisture (%)	-	77.70	76.67	77.53	75.86	76.10	-	-	-
Cholesterol (mg/100g)	-	95.17	111.82	106.05	71.21	82.23	-	-	-
Leucine (%)	-	7.67	7.88	7.78	8.45	8.13	-	-	-
Lysine (%)	-	8.87	8.68	8.60	9.57	8.90	-	-	-
Threonine (%)	-	4.11	4.15	4.45	4.13	5.22	-	-	-
Tryptophan (%)	-	1.14	1.15	1.25	0.78	0.70	-	-	-
Valine (%)	-	3.68	3.74	3.67	7.01	6.90	-	-	-
SFA (%)	-	42.04	38.84	38.16	34.17	34.53	-	-	-
MUFA (%)	34.88	23.46	24.01	27.15	29.96	31.97	-	-	-
PUFA (%)	14.84	26.66	30.44	27.62	28.92	28.67	-	-	-
n-6/n-3 (%)	10.07	5.09	5.85	3.85	3.27	3.59	-	-	-

Key - = data unavailable for that study; References: Woloszyn et al. (2006); Bernacki et al. (2008); Witak (2008)

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Table 2 - World duck meat production by Continents as at 2008		
Continent	**Duck meat production (Kg)**	**% Production**
Africa	57,100	1.51
North and Central America	112,000	2.96
South America	17,600	0.47
Asia	3,121,900	82.61
Europe	459,000	12.15
Australia	11,400	0.30

Source : FAO (2010)

Table 3 - World duck meat production (kg) by individual country within the past three years beginning from 2006			
Country	**2006**	**2007**	**2008**
China	2,175,300	2,328,200	2,518,200
France	233,400	246,800	248,600
Malaysia	108,000	111,000	111,000
Thailand	84,900	84,900	84,900
USA	85,600	83,400	84,000
Vietnam	86,000	84,000	84,000
Myanmar	67,900	74,200	74,200
India	70,200	72,800	72,800
Germany	38,500	55,800	60,800

Reference: FAO (2010)

However, high cholesterol level (especially low density lipoprotein (LDL) type) has been associated with cardiovascular diseases (Danaei et al., 2009). Duck meat also contain appreciable amount of saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acid (Table 1). Saturated fatty acid (42.04%), MUFA (34.88%) and PUFA (30.44%) was highest in P33, A4 and K2, respectively. The consumption of high SFA is a risk factor to develop heart related diseases due to increase concentration of LDL cholesterol in plasma (Danaei et al., 2009; Mozaffarian et al., 2009). A study suggested that to prevent chronic heart diseases, SFA intake should be replaced with PUFA intake rather than MUFA or carbohydrate (Jakobsen et al., 2009). The moisture content in duck meat ranged from 75.86% to 77.70%. Acceptable moisture content in needed to prevent excessive drip which will affect the acceptability of duck meat by consumers (Huff-Lonergan and Lonergan, 2005; Adzitey, 2011; Adzitey and Huda, 2011). Water helps regulate body temperature, protect body organs/tissues, carries oxygen, dissolves minerals and nutrients, lubricates joints, and moistens eyes, nose and mouths in the humans (Anonymous, 2012).

WORLD DUCK PRODUCTION

World duck meat has seen an increase in the past decade. There has been an increase of 0.28 million ton in 2000 to 0.37 million ton in 2008 with an average rise of 31% (FAO, 2010). Table 2 shows the current percentage of duck meat production by continents. From Table 2, Asia dominates in global duck meat production and accounted for 82% of the total duck meat produced worldwide. This was followed by Europe (12%), North and Central America (3%) and Africa (1.51%) and South America (0.47). The least producing continent was Australia (0.30%). By country, China is the leading producer of duck meat and produces about 67% of the total duck meat consumed globally, followed by France and Malaysia. Table 3 depicts the major duck producing countries from 2006 to 2008. In China duck production rose from 2006 to 2008 by 16%. Increased production indicates the high demand for duck meat in Chinese communities and a rise in income levels. There is also a switch over from traditional backyard or smallholder flock to large-scale commercial systems (FAO, 2010). The duck industry has grown significantly in Germany (58%) within the past three years although total output was still less than France (248.6 ton), the leading producer of duck meat in Europe. Thailand experienced no growth while outputs from countries such as USA and Vietnam experienced a decline of 2%. No country from Africa and South America is among the first nine main producer of duck meat.

CONCLUSION

Ducks like chickens are also important sources of proteins and lipids. Advancement in duck breeding programmes, selections, feed formulations and others have pave the way for improvement in duck performances, and their carcass and meat quality. According to this survey, the duck strain P55 could be the breed of choice due to it better protein percentage, water, cholesterol level and amino acid composition. This survey also revealed that duck production is of much greater importance in Asian and China compared to other continents and countries,

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respectively. The popularity of duck production in Germany should also be noted. Africa, Australia and South America countries produce duck meats in very small quantities.

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