Review Article

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FREE RANGE POULTRY HUSBANDRY AND PHYSIOCHEMICAL QUALITY OF MEAT: A REVIEW

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ABSTRACT

Recently high-quality meat products and bird's health are among the main domains in poultry husbandry systems as a result of consumer preference. The intent of the paper was to collect relative review regarding the influence of husbandry system on production and quality traits in poultry. Free-range systems show poorer feed conversion effectiveness and lower final body weight. Conversely, free range and improved farming; promote differences in texture, colour, chemical composition, protein, fat content and favourable fatty acid profile of chicken. Variation in these traits is due to genetic and non-genetic factors within the same husbandry system. The current review focuses on free range husbandry systems in production of poultry meat which can serve as determining tool in research directions and its practical applications.

Key words: Free range husbandry, poultry, productive traits, meat quality

INTRODUCTION

In the second half of 20th century, broiler chicken has been selected mainly to get higher meat production with decreased cost, results in increase of hybrid broiler strains. The broiler strain has efficient productive traits with good feed conversion potential, marked growth rate, higher yield of primal carcass cuts, cost effectiveness, and profit maximization. However, in last few decades' consumer interest in products from free range and organic farming system has increased because these systems are environment friendly and provide quality products [1,2]. The quality of animal products is being affected increasingly by safety of animal which is an important marketing strategy tool. Europe Union provides guidelines for organic livestock farming (EEC – the regulation for organic agriculture /EEC/ No. 1804/1999) and regulation for free-range production of chicken meat (Directive EWG 1538/91). Consumer prefer poultry meat products from broiler that are reared under free range rearing conditions as compared to indoor reared broiler [3,4]. Due to safety of birds and environmental protection, many countries adopted laws preferably for free range rearing system. Bancos compared organic and intensive rearing system, with improved birds condition and higher safety for organic husbandry system[5]. The characteristics of broiler chickens should be categorized by proper structure, better dressing percentage, proper dispersal of fat tissue, higher percentage of meat per carcass, along with proper color of skin. Breast, thigh, drumsticks and presence of specific tissue are characterized as main part of carcass and considered as important factor for defining the quality of broiler meat[6,7,8,9]. Despite these meat characteristics, many biological factors such as sex, age and genotype contribute to the quality of meat[6,10,11]. In last few years many researchers considered rearing of broilers, as one of main important aspects influencing the quality characteristics of meat[12,13,14]. The current review summarizes the literature pertaining to the implication of free range husbandry system on poultry meat quality and set a tool for future research direction with practical appliance.

Body weight and feed conversion ratio

Many researchers have broadly studied the impact of free range system on final body weight. Most of them have proposed that broilers in indoor husbandry result in higher body weight as compared to those in free range husbandry systems. However, it appears that the main factor affecting body weight of broilers is genotype, regardless of production system used. Slow growing

birds required 10 to 32 more days as a fattening requirement to achieve the same weight as accomplished by fast hybrids that required 42 days[9]. In USA, mostly fast growing birds are raised both for free range and organic system, whereas European Union regulations tend to use free range husbandry for slow growing birds that gain slaughter weight in 81 days[15]. This prolonged production period requires the use of slow-growing genotypes, inevitably leading to lower body weights at the end of fattening[9]. Though, fast growing birds achieve higher weight under free range husbandry conditions as compared to moderate and slow growing birds[16], whereas most authors suggested that slow growing birds should be reared under free-range raising conditions essentially because of their better adjustment to husbandry conditions and higher safety[17,18,19]. Fast growing birds are selected for higher production because of their adjusted movement, behaviour and reduced activity for forage[15], as stated earlier by Weeks[20], who ascertained that fast growing birds take more time outside or instantly inside the indoor husbandry than on the range, probably because of poor leg growth and excessive weight. Alternately, slow growing birds take much more time on the range, because of higher movement and better feeding of forage[6]. Fast growing breeds diminish their development potential to the extent of 25% as contrasted with intensively raised hybrids, though the decline in slow growing birds is just 8%, supporting slow growing genotypes in different husbandry systems[17].

Free range birds have lower body weight as compared to the birds reared under intensive condition due higher weight gain, feed utilization, and feed conversion ratio in intensive husbandry system[6] and comparable findings were also reported [21,22]. Free range birds fed on standard feed comprising of 18%, 20% and 22% raw protein in three phases showed lower body weights and feed intake as compared to indoor-raised hybrids[23]. A considerable difference in body weights of Ross 308 hybrids i.e. (1.650 kg vs.1.710 kg) was found for 42 days' husbandry under free-range and indoor system, while no difference was reported in feed conversion ratios[24]. Similar results were found in a study as evaluating the impact of husbandry system on Redbro and Arbor Acres strains, which showed that indoor-raised and free-range broilers results in body weights of 1.82 kg and 1.67 kg respectively[4]. Considerable differences in the feed proportion ratio (2.98 vs. 1.97) between hybrids in outdoor and indoor facilities were found by[25]. While, huge differences were seen in day by day picks up (25 g/dvs.56 g/d) and in the time needed to achieve slaughter weight (80 vs 45 days).

Mortality

Mortality is important both in free range and intensive husbandry because of its major contribution to poultry production. In intensive husbandry system, mortality is attributable to various factors like temperature fluctuation at early and later stages, inadequate feed intake, insufficient water supply and stock density[26, 27]. Major cause of death in free range and indoor system is due to higher contact with disease, parasites and predation[28]. Mortality rate increases in organic systems of about 6.4% in broiler due to predation[29]. The problem of predation in these production system is reduced with the introduction of genotype that do not have white feathers because of low exposure to potentially predators[30]. Furthermore, mortality and various infectious diseases are increased when free-range birds drink rainy water[31]. Mortality rate is also enhanced by the use of conventional birds in free range, increasing daily body weight of up to 60 g along with extending the growing period and ultimately higher body weight which will not be supported by cardiovascular and loco-motor systems[32,33]. Similarly, 2-4% mortality was caused by heart attack as a result of metabolic disorders[34].

Additionally, higher temperature in free range is also responsible for mortality[35,36]. Similar results were obtained while evaluating effect of temperature on husbandry system, Ross 308 birds showed 4.2% mortality in free-range birds and not a single case in indoor husbandry, likewise other studies showed mortality of 15% in free range and of 4% in indoor rearing[37,38]. Opposite results were found with 5.3% mortality in indoor and 1.3% mortality in free-range birds by Lima and Naas[25]. Still, all these outcomes show the importance and contribution of farm maintenance to the safety and mortality of chicken.

Primal carcass cuts proportion and dressing percentage

Research conducted on Cobb 500 broiler showed that husbandry system has no influence on dressing percentage[39]. Similarly, only 0.64% increase in dressing proportion in Ross 308 birds were reported in free range system as compared to indoor husbandry[37]. However, there is increase in dressing percentage in indoor system (69.90%) as compared with free range system (69.88%) with similar finding of increase in dressing percentage in 42-day old Cobb under intensive system as compared to free range [40,41,42]. Pavlovski et al found 0.40% increase in dressing percentage when compared indoor system with free range in Redbro and Arbor Acres broilers[43]. Most authors indicated that dressing percentage and slaughter traits may be influenced by genetic as well as non-genetic factors. Air temperature and diet also affect dressing percentage, with decrease in dressing percentage was reported, particularly in free range system because of increase in air temperature. Different studies showed influence of free range on the primal carcass cuts. Experiment conducted on two different breeds (Cobb 500 and Hybro G) showed no influence on primal cuts along with thigh and breasts in free range system as compared with indoor system [39,44], with comparable effects reported by Santos et al [45].

Comparative study on free range and indoor system showed increase in the yield of Gushi broilers thigh (27.75:26.68%) and breast (20.17:17.44%) meat in support of free range system[40]. According to Castellini et al[17] increased percentage for breast (23.2%:22%) was in favour of organic system when compared with conventional system up to 56 days' husbandry. Similarly, increase in period of fattening of Ross birds up to 81 days in organic system showed larger effect in the percentage of breast (25.2%:23.2%) and drumsticks proportion (15.5%:15.0%) respectively. Greater variation in thigh, breast and drumsticks percentage in (Hybro G) birds under free range system as compare to intensive condition with increased proportion of meat carcass in free range broiler[46]. Free range birds have lower proportion of abdominal fat content due to higher activity of these birds [6,40]. Likewise, (Hybro G) birds in another experiment under free range and intensive condition showed increase abdominal fat of 1.98% in intensive husbandry than free range (1.88%)[46], while similar result was found in an experiment on Gushi birds which showed increase abdominal fat percentage (6.5%) in intensive husbandry as compared to 3% in free range[40].

Fat and protein content

Free range husbandry system has strong effect on the chemical composition of chicken meat, mainly on the protein and fat content. In free range husbandry, genotype, breed, physical activity, availability of forage and slaughtering age are considered as main factor influencing chemical composition and

quality of meat[47,48,49]. The characteristic parameter of meat depends on choice of husbandry systems as organic system result in production of meat with better quality and improved sensory attributes[5,15]. However, besides these arguments numerous studies revealed ineffectiveness of husbandry systems on meat composition. According to the European Union regulations, chemical composition of leg and breast muscle in broiler aged up to 56 days is not affected by husbandry system under free range and indoor rearing systems[8]. Meat produced in slow growing Gushi birds when reared under free range and indoor systems have no significant differences in the content of fat and protein[40]. Similarly, Cobb broilers when reared under intensive condition up to 45 days and Paraiso Pedres and Master strain when reared up to a period of 85 days under free-range husbandry showed similar finding for protein and fat content. However, these studies came from the two most important parameters, the genotypes and period of rearing for fattening above all other consideration.

The effect of husbandry is less on protein content as compared to fats. Protein content of leg and breast muscle showed no variation in strains of Transylvanic Naked Necked under intensive and extensive husbandry system whereas lower fat content (1.8% vs. 3.9%) was found in free range husbandry[50]. Similarly, no difference was found for protein in drumsticks and breast muscle of Ross broilers under intensive and organic husbandry system for period of 56 days[51]. While, intensive husbandry revealed higher fat content both for drumsticks (2.83%vs.5.01% on day 56) and after 81 days it shows (2.47%vs.4.46%) and for the breast (0.72% vs. 1.46%) after 56 days and (0.74% vs. 2.37%) over a period of 81 days. Bogosavljević-Bošković et al reported higher percentage of protein in breast (0.71%)[52], drumstick (0.59%) and thighs (1.05%) for Hybro G chicks in free range as compared to indoor husbandry system. Bogosavljević-Boškovićet al[44] in an experiment with the same genotype reported (0.18% and 0.52% higher protein content in the breast and legs respectively in the free-range system; the fat content in the same system was 0.56% and 0.66% lower in the breast and legs respectively, than in the indoor system), while similar finding was reported by researchers[9,53]. Husbandry system under natural ambient conditions (sunlight, fresh air) influence the change in chemical composition as well as change in structure of tissue and organ both in free range and indoor condition[54].

Fatty acids profile

Fatty acid profile is an important quality parameter besides of fat and protein content in broiler meat. The higher percentage of saturated fatty acids is a main reason of cardiovascular disease which results in death in developed countries. Fatty acid profile of poultry meat may be influenced by breed and production systems, however nutrition plays major role in describing these parameters, such as availability of pasture and fresh plants should be considering primarily for consumption of chicken. Content of fatty acid and individual fatty acid ratio in broiler meat can be modified through diet[15]. Cardiovascular disease is caused mainly due to higher intake of saturated fatty acids and cholesterol. Intake of unsaturated fatty acids, particularly omega-3 fatty acids, and decrease in the consumption of saturated fatty acids can reduce the risk of these diseases[55]. Consequently, human population gained health benefits from chicken meat as microflora of broiler is not utilized these unsaturated fatty acids and serve as source of omega-3 fatty acids[56,57]. Meat quality and level of unsaturated fatty acids was improved by consuming grass due to active substance in it[58]. However, feed conversion proportion and weight gain can be decrease with increase intake of tissue-rich feed. According to Sekeroglu et al fatty acid contents were not significantly influenced by husbandry system in Ross broiler breasts[23].

Leopold Centre researchers associated three husbandry systems for chicken, containing free-range, conventional and organic system and recommended that[53]: organic birds had a lower percentage of monounsaturated (31.67%) and saturated (30.14%) fatty acids as compared to conventional (32.31% and 39.13%) and free-range systems (32.46% and 38.82%). However higher percentage of polyunsaturated fatty acid was found in organically (38.19%) produced meat, as compared to conventional (28.57%) and free range (28.72%) husbandry systems. Similar results were obtained by on organic and conventional systems for monounsaturated and polyunsaturated fatty acid[17]. The fatty acid profile for breast muscle that are reared over a period of 81 days showed higher percentage of SFA (37.87%): MUFA (29.72%), PUFA (32.38%) under organic system, as compared to intensive husbandry which showed lower percentage of SFA (35.87%), MUFA (35.87%), PUFA (31.15%). Similarly, percentage of palmitic acid in free range access was lower in breast (23.7%) and legs (22.7%) as compared with indoor reared birds (25.7% and 26.6%) respectively[50,59]. Two different breeds (Red Bro Cou Nu and Ross) were studied under varying slaughter ages and production condition i.e. Ross broiler fattened over 56 days under intensive system and slow growing strains fattened up to 81 days in free range system. The results were opposite about the concept that slow growing birds under free range husbandry give nutritionally high quality meat. The content of polyunsaturated fatty acids (36.9%) particularly n-3 (2.93%:2.47%) and n-6 (33.9%:28.6%) fatty acids were higher under intensive husbandry as compared to Label broilers (31.1%). However, Label broilers had higher monounsaturated fatty acids (27.2%) as compared to intensively reared Ross birds (24.3%). The overall fatty acid profile was improving through diet and free range system as showed many author in their studies.

Meat Colour and pH

The pH, cooking loss, tenderness and colour are important parameter for the quality of poultry meat and determine its technological suitability for processing[60]. Meat consumers prefer the colour as most important quality parameter, when buying whole or part of poultry carcass. Chickens reared under free ranges were characterized by a brighter colour of meat and a higher contribution of yellow colour in muscles due to the content of natural carotenoids in green forage[15]. The variation in skin colour is the attribute of melanin pigment in dermis and epidermis which is the characteristic of birds to produce, deposit and absorb the carotenoids[61]. Similarly, active acidity (pH) is the parameter being a direct indicator of meat quality and has impact on other characteristics such as water-holding capacity, colour and tenderness[24,62]. Free range system has no significant impact on physico-chemical and technological parameters of meat, however the effect on breast muscles pH was prominent. Moreover, ultimate pH, the feature of normal meat, was attained in both groups: indoor birds 6.00 and in free range 6.19[63]. Poultry meat under free range husbandry provide more bird's safety, low stress condition and have low pH due to minimum utilization of glycogen (Castellini et al., 2002b; Fanatico et al., 2007; Wang et al., 2009).

Cooking Loss

An important factor that may have adverse effects on sensory perception is cooking loss which indicates the quantity of meat juices lost during thermal treatment. The high value of cooking loss may intensify the sensation of a lack of juiciness or even

dryness of meat, which significantly affects the overall sensory acceptability of meat. Higher losses upon heat treatment were observed in muscles of the chickens with no access to free range husbandry[64]. Fanatico et al observed an opposite tendency[3], they determined a higher cooking loss from breast muscles of slow-growing chickens that were using free range, compared to the birds indoors husbandry. In addition, these authors emphasize that the discussed parameter is significantly affected by genotype. Breast muscles of slow-growing birds are characterized by higher cooking loss than those of the fast-growing ones as studied by researchers[3], which was also confirmed in a research by Debut et al. (2003).

Water Holing Capacity

A significant physicochemical parameter is water holding capacity of meat. A high water holding capacity (WHC) value can positively influence meat juiciness. A lower WHC in muscles of chickens were found under free ranges[17]. The sensory evaluation of meat is also directly influenced by tenderness. Poultry products from pasture fed chicken have good sensory attributes with a higher sheer force of breast muscles assayed in the chickens in free range husbandry[64,66]. Similarly, texture and the associated shear force value, along with tenderness of meat is higher in free-range birds due to their greater physical activity as compared to the chicken meat under standard and indoor production system[3,51].

CONCLUSION

In conclusion, free range and organic poultry have positive affect on the quality of meat, particularly chemical composition. Improved products quality, bird safety, and protection of environment are the main characteristics of free range husbandry system. Further research can elaborate the possible solution to the factors influencing the production traits of birds and quality of meat.

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