Issues of sustainability on the Brazilian broiler meat production chain

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Abstract. Brazil is the world's largest broiler meat export. The sanitary control, knowledge and technology, as well as the natural aspects of the country are pointed as the key for the success of the product on the market. In this paper, an overview on the ammonia emission of the Brazilian broiler meat production chain from 2005 to 2010 is presented. The emission of ammonia was estimated on 700 thousand tons per year, which may implicate in the decay in the surrounding environment near the production areas. Brazilian broiler production creates jobs and has a significant social rule in Brazilian economy; however in the other hand, the implications of emitting this amount of ammonia to the atmosphere may be undesirable. Advances in developing new fodder technology are needed, in order to mitigate this issue.

Keywords: meat market, broiler meat supply chain, sustainability.

1 Introduction

Broiler meat is one of the most important meats in the global market. It is now the world's second most consumed, only behind pork and followed by beef. This is due to a few critical factors such as low relative price compared to other meats; great image with the consumer as it is considered a light meat; acceptance by most cultures and religions, and it present a wide range of products based on broiler [1]. Brazilian broiler meat is both domestically and internationally marketed as whole carcass or in cuts, with an aggregate value. The most significant importers are the Arab countries, Asia and Africa [2].

Brazilian broiler farming became crucial to the agribusiness since the last twenty years. The dynamism of broiler activity is linked with constant productivity gains, particularly through the improvement of feed conversion rates, earning nutritional gains, genetic research, the increased automation of broiler and better production management [3]. Brazil is nowadays the third largest world broiler producer and is the world's first export of broiler meat [2].

The demand for broiler meat has increased worldwide. The industrial-scale broiler farming was highlighted from the 50's, replacing the commercial broiler industry of the 20's and 30's. Investments in research also began to gain strength from the 50s,

with the establishment of agencies related to broiler production with multidisciplinary aspects. Broiler chain has been structured encompassing producers, suppliers and partners. In the 2000s, the United States had the hegemony in the production and export of broiler meat [3]. However, the country was seriously affected by avian influenza, which also affected Canada and Indonesia in 2004. At that time, Brazilian producers presented a well-structured and competitive business, reaching the world's leadership in exports of this meat.

After the establishing of Kyoto's protocol, several countries agreed to proceed with the noxious gases emission accounting, in order to reduce emissions. This was done initially in urban industries; however, initially in Europe and afterwards followed by the U.S. and Canada, several authors provided this accounting for animal production [4; 5; 6]. This is yet incipient in Brazil, although some initiatives are presented [7; 8; 9]. Ammonia is a noxious gas that may cause damage to the environment. Animal production facilities are the largest generators of ammonia, nitrous oxide, methane and carbon dioxide in the atmosphere and contribute to soil acidification and global warming [4; 5].

Using a rather unsophisticated housing structure for rearing the birds, the input of the broiler meat production chain is the rearing of one-day-old pullets, and the feedstuff provided by the integration companies. The output in this research was reduced to the meat production and the litter and the carbon dioxide and ammonia emissions from the flocks. This research estimates the ammonia output of broiler production under Brazilian conditions using the production data from 2005 – 2010.

2 Methodology

This research had two parts; first, broiler supply chain was described, with its actors, roles, functions and market data. The data were organized, and the supply chain was studied in a simplified way, into two segments (1) input to produce broiler meat; and (2) the output of broiler meat production.

The supply chain was studied, and the actors were identified, as well as their role, and the flow of products in and out the supply chain (Figure 1, Table 1).

Brazilian broiler meat production chain

Data for describing the broiler supply chain were collected from 2005 to 2010, either in direct sources or calculated based on published data (Conab; Embrapa Swine and Poultry; Avisite; Organization for Economic Co-operation and Development/OCDE; Food and Agriculture of the United Nations/FAO; Ministry of Development Industry and Foreign Trade/MDIC; United States Department of Agriculture/USDA).

The chain output was developed from data information from the chain links and actors.

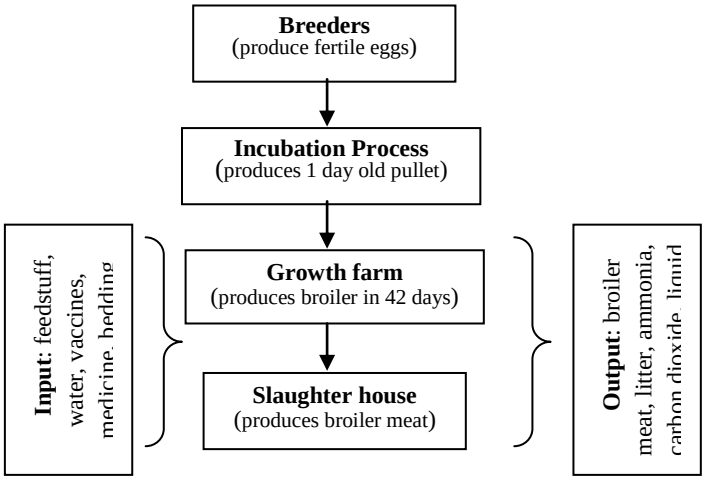


Figure 1. Simplified scheme of the broiler meat supply chain indicating its input and output

Table 1. Input and output data of the Brazilian broiler meat supply chain from 2005 to 2010.

Year	2005	2006	2007	2008	2009	2010
			Input (10^3 ton)			
Pullet	0.20	0.19	0.22	0.23	0.23	0.25
Feedstuff	11.10	12.25	12.99	12.76	12.94	14.25
			Output (10^3 ton)			
Meat production	7.04	7.56	7.96	8.23	8.29	9.37

Based on the amount of meat produced, an estimation of the ammonia emission of the chain was calculated using Equation 1.

Ammonia emission estimation

For estimating ammonia emission, data were originally obtained from two field researches using eight aviaries with mechanical ventilation tunnel type. Mean values of litter pH and litter temperature were recorded using a flock of 100 thousand broilers, which is the normal flock produced in Brazilian integration. The estimation of ammonia emission was done using the model described by [8]:

$$E = \exp(-6.5 + 0.03\,day + 0.12\,Tc + 0.61\,pH - 0.0043\,day^2) \quad \text{Eq. 1}$$

where day = day of growth (day), Tc = average litter temperature (°C); and pH = litter pH. An algorithm was built and a software was developed using Visual Basic for describing the ammonia emission of broiler housing. Mean values of pH and litter

temperature were adopted from field records, and the calculations used the day 42 as the critical day, when the birds are harvested for slaughter.

3 Results and Discussion

Evolution of the Brazilian broiler meat production chain

The use of innovations and technology has been also responsible for the good results in Brazilian broiler meat production. In 1930, the bird weight was 1.50 kg; the feed conversion rate was 3.50 kg and the slaughter age was around 105 days. In 2005, those indexes were remarkably different: bird weight was 2.24 kg; the feed conversion rate around 1.80; and slaughter age is at 42 days. Brazil has also achieved considerable production results with the health inspection carried out in the country, which led to achieve confidence of new markets, and it has adapted to the demands of the globalized world (Table 2).

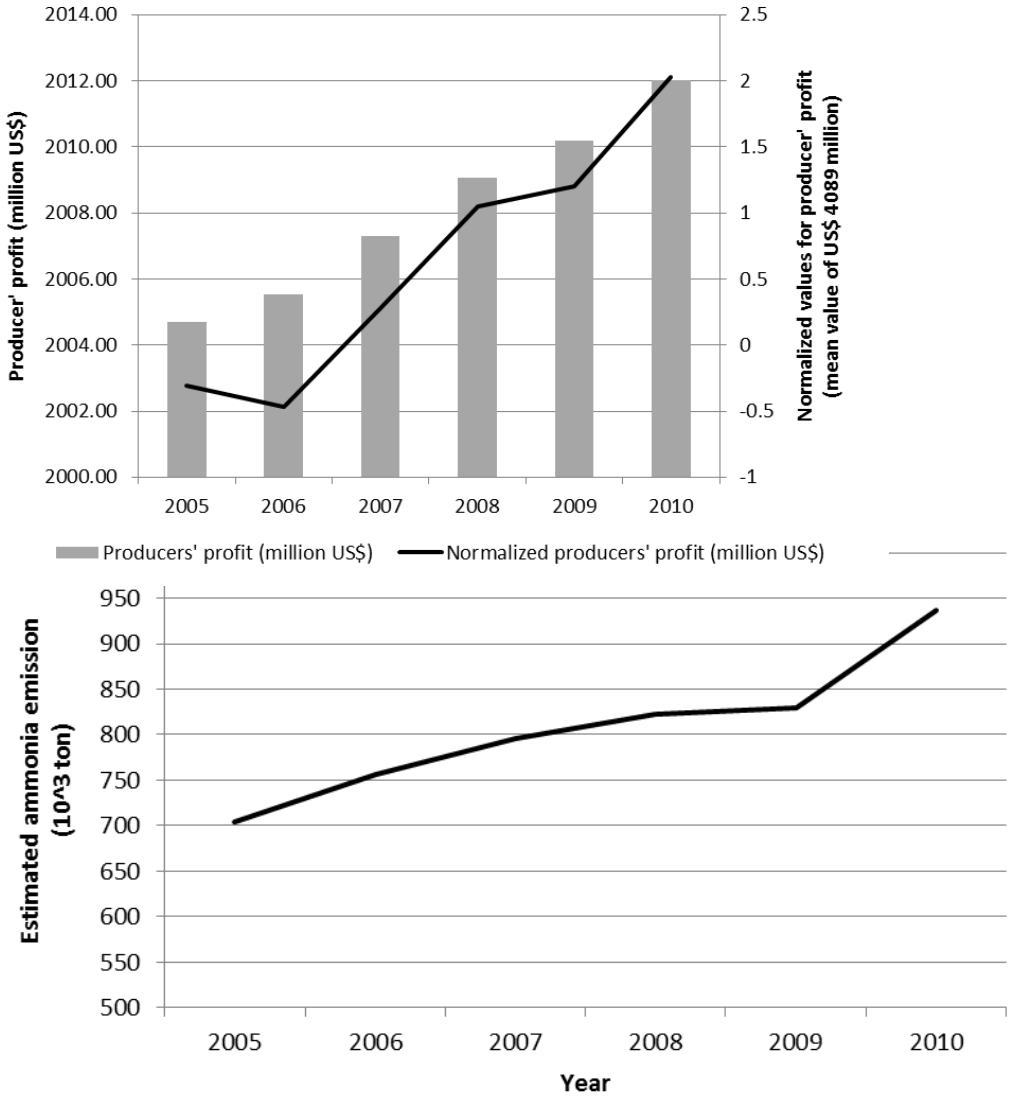
Table 2. Technical indicators of the evolution of Brazilian broiler production.

Year	Bird Weight (g)	Feed Conversion rate	Slaughter Age (day)
1930	1.50	3.50	105
1940	1.55	3.00	98
1950	1.80	2.50	70
1960	1.60	2.25	56
1970	1.70	2.00	49
1980	1.80	2.00	49
2005	2.24	1.80	42

Source: [10]

According to [3], the growth in 2010 was largely driven by increased consumption of broiler meat and the 5.1% expansion in exports, boosting competitiveness in foreign markets. In 2010, exports reached high records, taking Brazil to the position of leading world exporter of broiler meat, with a total of 3.8 million tons of broiler exported to over 150 countries, followed by the United States. Factors such as the use of advanced technology, proper sanitary control to international standards and favorable exchange rate for exports, helped Brazil achieve those results.

Results show that Brazilian broiler production activity evolved positively in the last five years, and it was weakly influenced from international virus outbreak, as none of the virus troubling broiler production was found in the country. Although products trade presented a steady movement up to the year 2006, from that time on there was a significant increase in both financial exchange and producers' profit. According to the trend, consumers' profit will continue to increase rapidly in the next years, unless some unexpected event emerges in the future, in the international scenario (Figure 2).



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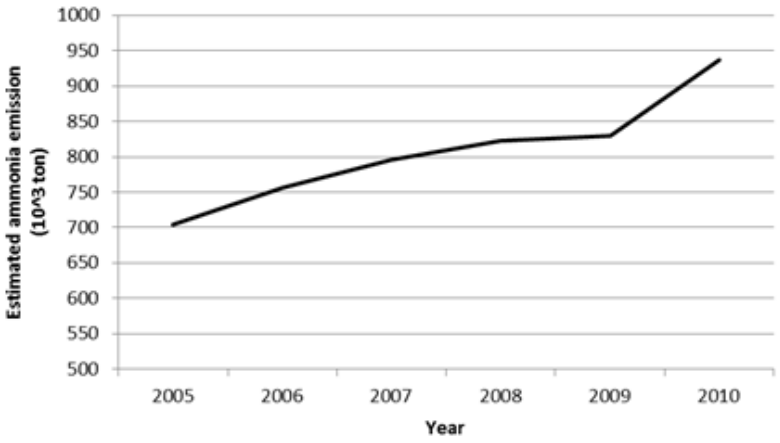

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Figure 3. Estimated ammonia emission of Brazilian broiler meat production from 2005 -2010

This value can vary depending on the litter substrate material, number of flocks reared on this litter, drinker type, and the kind of general management of flocks [11]. In general pH varied from 8.0 to 8.5 depending on the acclimatization system adopted and the flock density (birds per square meter).

From all this causes of variation in ammonia emission, litter material is the most important. It is found in current literature [9; 11; 12] that new wood shavings bedding material reduces ammonia emission in flocks; however, when computing the amount of trees used for producing wood shavings, this may not be sustainable. If re-using the litter, ammonia concentration can be increased inside the shelter with severe implications on the animal welfare.

7 Conclusions

Brazilian broiler production is a large industry, and it generated economic growth within the last five years. However, the output of this industry concentrates large emission of ammonia, which is related to climate change. A better interpretation of the wide range of emissions rates can be made once characteristics of the litter, flock, and house management can be incorporated into data analysis

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