

The differentiation with proventriculus, gizzard, and pancreas (fuller

[Nutrition](#)



The way how to estimate methane emissions from enteric fermentation which given by the IPCC (Intergovernmental Panel on Climate Change), the organization Guidelines recommended multiplying the number of animals for each animal category by a Corresponding emission factor (IPCC, 1996). However, we do not have such methane emission factor for poultry and the poultry methane emission is not clear for us. Clearly, predominant methanogenic species found in chicken ceca is *Methanobrevibacter woesei* (Suwat Saengkerdsub et al, 2007). Additionally, archaea, methanomicrobiales, methanobacteriales also occur in the ileum digesta and cecum content in poultry.

G1 Therefore, before the food emptied from crop by peristalsis.

G2 G3 G4 G5 Generally, Microbial activity occurs there during the storage of food. Theoretically, the poultry crop and cecal is a kind of smaller Ferment chamber, the digesta from crop go through the proventriculus and gizzard arrive at duodenum, jejunum, ileumG6 , caeca, colon, cloaca, respectively, then excreted out of the cloaca in the form of mixed urine and feces, the major microbial fermentation will occur in the cecal and produce the methane and volatile fatty acids. Moreover, in chickens digestion tract, the bacterial activity is more intense in the crop and small intestine (jejunum, duodenum, ileum), and the ceca in differentiation with proventriculus, gizzard, and pancreas (Fuller et al., 1984). The most densely populated microbial community within the chicken gut lumen is found in the ceca, the ceca is a pair of blind-ended sacs that open off the large intestine (BarnesG7 et al.

, 1979; Clench et al., 1995; Deusch et al., 2015; Meng et al.

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, 2017). Based on prof. D. Józefiak's suggestion, there have 10% of energy needs is recovered from a well-functioning in the cecum (D. Józefiak et al., 2004; Hegde et al., 1982). The majority of fermentation in laying hens occurs in the ceca which supply a steady environment for autochthonous microflora such as Bifidobacterium, Eubacterium, and Propionibacterium (Józefiak et al., 2004). More than two hundred dissimilar bacteria have been isolated and most of these are harsh anaerobes. meantime, Tsukahara and Ushida (2000) reckon that thirty to forty percent of the maintenance energy for monogastric is derived from microbial fermentation. The crop of chicken where food can be stored, followed by a proventriculus (chemical stomach) which leads to the muscular gizzard (physical stomach), where digesta are grinding, before entering the small and finally large intestine, by feeding high percentage of fiber also can be dramatic increase in the size of cecum (Jorgensen et al., 1996), that means feed higher value of fiber perhaps will increase the methane emission in poultry (chicken etc). In the cecal, the SCFA (short chain fatty acids) will produce during the fermentation of non-starch polysaccharides in the GIT (gastrointestinal tract). However in the ceca, inhabited mostly by strict anaerobes, lactobacilli accounted for only 8% of the library sequences (Ptak et al.

, 2015; Lu et al., 2003), mainly because they produce lactic and acetic acids, which leads to pH reduction (Engberg et al., 2004; Józefiak et al., 2012), generally, the satisfied pH condition for methanogens is between 6~8, therefore, concerning the SCFA not only a kind of nutrition but also cab be dropped the pH, so it is will inhibit the quantity of methanogens

(Meimandipour et al., 2011). G8 G9 G10 G11 G12 G13 The main function of chicken ceca where is fermentation chamber can fermentation polysaccharide, and also absorb water, function as urea recycling, (Deusch et al., 2015; Meng et al.

, 2017), The chicken gastrointestinal tract microbiome comprises more than 900 species of microorganisms G14 (Apajalahti et al., 2004). Recently, some researchers (Sergeant et al., 2014) reported that chicken ceca possess approximately 700 bacterial species based on 16S rRNA amplicon pyrosequencing. G15 G16 In the chicken gastrointestinal tract, the cecum has the highest microbial activity. concealing roughly 10^{10} ~ 10^{11} certain anaerobes per gram based on the wet weight (Jensen et al.

, 1996), However, there have 10^8 ~ 10^9 methanogens per gram of rumen digesta. G17 G18 In chicken case, the cecum functions as a fermentor to provide energy. G19 G20 The Józefiak's studies had been concluded that eight percent of the energy requirements of chickens are derived from VFA which connect with methane emission (Józefiak et al., 2004). Surprisingly, few studies have reported methane gas production in the chicken ceca. In addition, the age of birds may be a factor as methane gas emission has been reported to arise in cecal contents from two-month G21 age birds. (Marounek et al., 1998).

Meanwhile, there also have extra study had been shown us that the methanogens were found from cecal samples of very young chicks by measuring FISH (fluorescent in situ hybridization) (Zhu et al., 2003).

However, concerning the mechanism of methane formation in the poultry

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section, we know that both chick and adult chicken have archaeobacteria in the cecal, based on our experiment data (not published) we also observed that archaea, methanobacteriaceae, methanomicrobials use cecal as their G22 G23 G24 G25 parasitism harbor and we also determine that hydrogen occur in the cecal after cecal content 7h fermentation in syringe system, the gas was determined by gas chromatography 310. such methanogens can use hydrogen and carbon dioxide to produce methane in the cecal. because the pH of cecal content generally is near to 6.9 and pH requirements of the archaea is 6~8 (Jones et al.

, 1987), so prove that cecal is a major G26 G27 parasitism harbor for methanogenic archaea indirectly. the crop, proventriculus, and gizzard have low pH and cannot support methanogenic archaea to live.

G28 G29 G30 G31 Sixty-seven years ago, only 7 species have been successfully isolated and cultured from the rumen, including *Methanobacterium formicicum*, *Methanobacterium bryantii*, *Methanobrevibacter ruminantium*, *Methanobrevibacter olleyae*, *Methanobrevibacter millerae*, *Methanomicrobium mobile*, and *Methanosarcina barkeri* reported by Rea et al at 2007. Methanogens are members of the territory Archaea and are classified G32 to the kingdom Euryarchaeota (Woese CR.

, 1990). Because Methanogenic archaea (methanogens) are a phylogenetically well-defined group of G33 rigorous harsh anaerobes, with a metabolism used hydrogen and carbon dioxide in the formation of

methaneG34 directly (Thauer et al., 2008). In our experiment's view, the pH of cecum content is 5.5~6.

6(unpublished experiment data) for broiler chicken. It has been showing us G35 G36 modify the feed formula can decrease the methane emission mainly by decreasing the population of methanogens. Because one of the most important reason is pH is too low G38 occurs G39 in the cecal and the condition can not support methanogens to live anymore. In poultry, extensive rigorous anaerobic activities including formation of short-chain fatty acids (SCFA) and methanogenesis occur in the ceca of birds fed a variety of diets (Ricke et al., 2004). Short-chain fatty acids have been shown to modify the bacterial ecosystem in the ceca. So concerning the cecal is a major port for methanogens to generate the methane from the poultry sector, It is still a fascinating part for researchers. G40

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