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Review

Pelleting of broiler diets: An overview with emphasis on pellet quality and nutritional value

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ABSTRACT

Pelleting is the most prevalent heat treatment in the production of poultry feed. The objective of pelleting is to agglomerate smaller feed particles into larger particles as pellets to enhance the economics of production by increasing the feed intake, and thus growth performance and feed efficiency. However, due to the heat, moisture and mechanical pressure applied during conditioning and pelleting, some chemical and physical alterations occur that may have beneficial or detrimental effects on feed components, gastrointestinal development and subsequent bird performance. Pelleting process has been shown to gelatinise starch, but only to a small extent, and thus may be of modest relevance in starch digestion. Pelleting process may also result in partial denaturation of proteins; a process which can potentially improve protein and to some extent starch digestibility due to inactivation of proteinaceous enzyme inhibitors. Cell wall breakage, as a result of the physical stress of pelleting, may also provide greater accessibility of nutrient contents, previously encapsulated within endosperm sub-aleurone, to digestive enzymes. In diets based on viscous cereals, nutrient availability may be negatively affected through increased digesta viscosity as a result of either an increase in soluble carbohydrate concentration or changes in the molecular weight of soluble fibres or both, due to pelleting. Pelleting process also remains a potentially aggressive process on the stability of exogenous feed enzymes and vitamins, a major concern of feed manufacturers. Particle size-reducing property of the pelleting process may result in a suboptimal gizzard development and thus reduced nutrient digestibility of diets for poultry. While physical pellet quality is a critical factor to optimise feed efficiency and growth response of broilers, the present review highlights that it is the balance between nutrient availability and physical quality of pellets which is critical in determining the actual performance of broilers. Under the conventional pelleting process, good pellet quality is usually obtained at the expense of nutritional quality. Research is warranted to identify and evaluate possible strategies to manufacture highly digestible high quality pellets. Such strategies will require novel approaches of improving feed hygiene which are not detrimental to feed nutrients.

Abbreviations: AA, amino acid; AMEn, nitrogen-corrected apparent metabolisable energy; BW, body weight; BWG, body weight gain; CP, crude protein; FI, feed intake; Lys, lysine; N, nitrogen; PDI, pellet durability index; RDS, rapidly digestible starch; RS, resistant starch; SDS, slowly digestible starch; TMEn, nitrogen-corrected true metabolisable energy.

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Contents

1. Introduction

Feed is the greatest cost item in broiler production representing 60–70% of the total production cost, with the cost of ingredients accounting for the major portion of feed cost. Feed processing further adds to the cost of feed (Nolan et al., 2010). However, feed processing provides an opportunity to improve broiler performance. Therefore, an emerging area for research in poultry nutrition is the preparation of feeds prior to ingestion to increase the value of the feed. There are many possible strategies to improve feed processing techniques; however, the cost of each strategy must be carefully weighed against achievable performance improvements and negative effects in the target animal (Behnke, 1996).

Pelleting is the most common thermal processing method in the production of poultry feed. The main aim of pelleting is to agglomerate smaller feed particles by the use of mechanical pressure, moisture and heat. A major step in the pelleting process is the conditioning of mash prior to pelleting (Skoch et al., 1981), which is generally accomplished by adding steam to the mash feed.

Offering feed to poultry in pellet form enhances the economics of production by increasing the feed intake (FI), and thus growth performance and feed efficiency. On the other hand, the process of making pelleted diets may also have detrimental effects on the production through chemical and physical changes that occur during pelleting (Svihus, 2011; Svihus and Zimonja, 2011). The purpose of this review was to describe pelleting process, physical pellet quality, motivations for pelleting, and beneficial and detrimental effects of pelleting process on feed components and broiler performance. The potential manipulations and considerations by which physical and nutritional quality of pellets can be optimised were also discussed.

2. Description of the pelleting process

Feed processing refers to any treatment to which animal feed undergoes prior to ingestion (Maier and Bakker-Arkema, 1992). Feed processing technology has witnessed substantial improvements, from a hand scoop shovel as the basic mixing tool (Schoeff et al., 2005) to various processing operations which are currently performed utilising modern feed technology (Deyoe, 1976). The widely used processing operations in feed manufacturing plants are:receiving the raw materials, grinding or particle size reduction, proportioning or batching, mixing, heating or thermal treatment (or pellet shaping), packaging, warehousing and loading. Each of these operations can influence feed quality and bird performance.