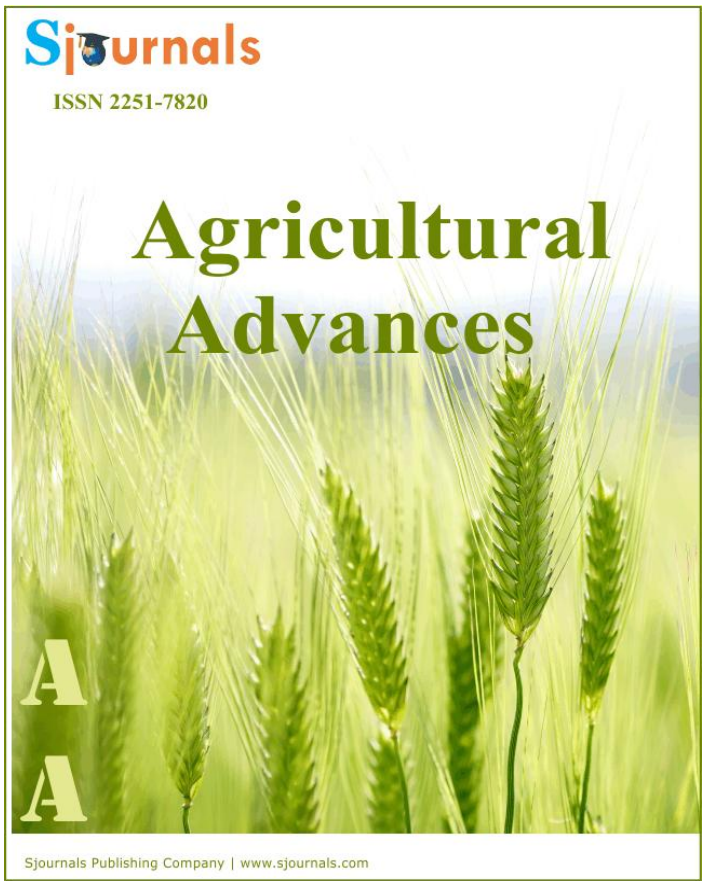

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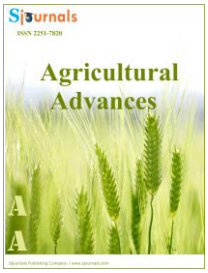

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Review article

The essence of weaning age and its significance on performance, mortality, carcass and meat quality properties in rabbits

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ABSTRACT

Weaning age is one of the critical components under management practices which can affect the profitability of a rabbit enterprise, because of its consequence on productive traits, mortality, carcass and meat quality properties in rabbits. Choice of weaning age suitable for a particular production system which brings about positive change in productive traits, mortality, carcass and meat quality properties in rabbits is bound to increase economic returns. There has been inconsistence in the observations made in different studies on the influence of early versus late weaning on productive traits, mortality, carcass and meat quality properties. This has made the comparison of different studies to ascertain optimum weaning age questionable, due to the fact that performance, mortality and carcass parameters results are derived from rabbits slaughtered at the same weaning age, but differing in their nutritional regime, slaughter weight and genotypes. Different fixed effects (production system, nutrition, slaughter weight, genotype, etc.) and their interactive effect with weaning age in various studies have been a source of variation in productive traits, mortality, carcass and meat quality properties. Genetic groups might differ in productive traits, mortality, carcass and meat quality properties at the same weaning age, hence it's necessary to determine the optimum weaning age in different production systems for different genetic groups. This is on the backdrop that the choice of inappropriate weaning age in rabbits may reduce productivity and increase mortality as well as affecting

carcass parameters adversely. It has been noted that any management practice which do not curtail mortality compromises on total meat output ending up in reduced income earned from rabbit production. It would be reasonable to conclude that performance of rabbits, the resultant carcass and meat quality properties as well as mortality rates depend greatly on the management practices such as weaning age and its interactive effect with other factors adopted during the production cycle. This review looks at the effects of weaning age on productive traits, mortality, carcass and meat quality properties in rabbits.

1. Introduction

Age at weaning is a management practice that has a bearing on growth, production and survival of kits (Obike et al., 2014). Hence, the choice of weaning age is one of the important and predictable management practices which can positively and/or negatively influence productive traits, mortality, carcass and meat quality properties in different production systems. In other multiparous species, weaning age has been reported to affect growing animal performance, and mortality rates: guinea pigs (Fonteh et al., 2005) and swine (Smith et al., 2008). Depending on the individual producer's production system used or objectives, age at weaning appear to vary from 21 to 45 days of age. Different production systems have known to employ a range of diverse weaning age in rabbit production (Daszkiewicz et al., 2012). In intensive, semi-intensive and extensive production systems have used 28 to 30, 35 to 40, and 45 days of age for weaning, respectively (Bivolarski et al., 2014). Weaning kits at 5 weeks is deemed early weaning and after 8 weeks implies late weaning, while 5.5 to 6 weeks of age serves as standard. It should be noted that the effect of weaning age on productive parameters is marked, and differ by mainly on its interactive effects with other factors such as nutritional regime, genotype, housing to name a few. Some studies have established that early weaning is an appropriate way to furnish precise adapted nutritional requirement to young rabbits (Xiccato et al., 2004; Feugier and Fortun-Lamothe, 2005). However, early weaning showed reduced live weight as compared to late weaned rabbits (Gallois et al., 2004). Deferment (late weaning) of weaning age has an advantage of reduced stress in young rabbits (Marongiu et al., 2008) because stress can complicate a precarious imbalance within the young rabbits' alimentary canal whose gut microbiota is still undeveloped. With increasing age, the population of gut microbes continuously increases and leveled at weaning (Bennegadi et al., 2003). This is on the backdrop that feeding has an effect on the evolution of the alimentary canal and its complex and existence of micro flora. Maronguiu et al. (2008) working with growing rabbits weaned at 28 and 63 days of age implicated delayed weaning on reduced profitability in rabbit production. Substantial amount of resources has been spent on wide ranging studies on the influence of various factors (genotype, nutrition, physiology, health, etc.) other than ascertaining optimum weaning age on productive traits, mortality, carcass and meat quality properties in rabbits (Vachkova et al., 2010; Maertens et al., 2008; Ouyed and Brum, 2008; Tumova et al., 2006; Ashour et al., 2001). This review looks at the effects of weaning age on productive traits, mortality, carcass and meat quality properties in rabbits.

2. Weaning age and productive traits

Positive and/or negative effects of both early and late weaning age on productivity and economic return in rabbit have been reported several authors in literature (Feugier and Fortun-Lamothe, 2005; Xiccato et al., 2004; Pascual, 2001). Weaning in rabbits is an intricate process which inflicts dietary, environmental and psychological stress as a result influencing rabbit's productivity (Gabr et al., 2017) and an enterprise's economic returns. After weaning kits go through a stressful period characterized by inconsistence weight gain, conspicuous weight loss and possible total cessation of growth, in some instances death. Depending on the targeted performance and production system used rabbits can be weaned at different ages. Extensive, semi-intensive and intensive systems wean young ones at 35 to 42 days, 28 to 35 days, and 21 to 28 days of age post-partum, respectively (Ferrian,

2012). At around 28 days of age (4 weeks) kits entirely have an innate capacity to feed themselves on dry food. This correspond with the dam's ability to produce another litter at 31 days after the previous litters birth. Physiologically, milk intake in kits is at its highest at around 3 weeks of age and it diminishes between 4 and 7 weeks. Rao et al. (1978) suggested that weaning kits at 4 weeks will allow the doe to get prepared for another litter. Xiccato et al. (2001) reported poor body condition of reproductive does as weaning age progressed from 21 to 32 days. This implies early weaning at 4 weeks of age may will arrest the negative body condition of the reproductive does (Pascual, 2001). The poor body condition caused by the continued suckling of rabbit kits after for weeks can be detrimental to the reproductive process of the dam.

The economic returns in rabbit production systems are partly influenced by weaning age because of its consequences on subsequent growth performance as this affects the accomplishment of the final slaughter weight. It is important note that heterogeneous weaning ages is typical among rabbit producers in different production systems. This chaotic management practices have adversely affect productivity and profitability. Studies giving an account of age of weaning to growth rate and survivability of kits have been nominal in literature (Obike et al., 2014). The literature about productiveness in relation to weaning early of growing rabbits is rather conflicting. Trocino et al. (2001) comparing early weaned rabbits with those weaned at 32 days of age observed that early weaned rabbits registered lower body weight during fattening than their counterparts. The trend in growth rate reduction in early weaning was from 4 to 26% (Barreto and De Blas, 1993). This concord with observation by Ferguson (1997) who reported a negative influence of early weaning on body weight, however, early weaning had no influence on body weight (Gidenne et al., 2004) and resultant meat production (Rao et al., 1978). Mahunguan (2016) comparing rabbits weaned at 4 weeks achieved and 8 weeks, 4 week weaned rabbits recorded a higher market weight than those weaned at 8 weeks of age, however this was ascribed to improved feeding. Performance differed with genotype, California had better weights than New Zealand White at the same weaning age (8 weeks). It is reasonable to suggest that there is an interactive effect of weaning age with genotype. Therefore, it is imperative for studies to ascertain optimum weaning age for different breeds. Higher body weights were registered in rabbits weaned at 35 days of age and slaughtered at 95 days of age than rabbits weaned at 21 days of age (Vachkova et al., 2010). However, it has been noted that the poor growth performance as a result of early weaning is compensated at a later stage. Fortun-Lamothe et al. (2001) reported that rabbits weaned early resulted in higher viability and improved growth rate. This might be ascribed to kits being able to ingest efficiently solid and fibrous feed earlier in life. However, this is in contrary with report by Xiccatto et al. (2000) who observed that early weaning did not influence viability. On a slightly different note, Feugier et al. (2006) reported that early weaned rabbits did not demonstrate a higher solid feed intake in comparison of suckling rabbits weaned between 23 to 35 days of age. Growth rate was comparatively higher by 0.584 points in traditionally weaned kits than those weaned early. Therefore, it is reasonable to suggested that low feed intake could have resulted in depressed growth rate in this study. Piattoni et al. (1999) comparing rabbit performance of rabbits weaned at 18 days of age instead of weaning at between 28 to 35 days of age kits experienced off feed for 1-2 days but their food consumption steadily increased after withdrawal. It is reasonably to suggest that this scenario could have compromised the growth of the 18-day weaned group on growth performance. The off feed could have been exacerbated by the inefficient of handling solid feed by the young growing rabbits. Gidenne and Fortun-Lamothe (2001) reported that 32 day of age weaned rabbits were significantly lighter than unweaned ones, but the differences disappeared as age (50 days of age) progressed. This has been supported by observations by Xiccato et al. (2000) at the same age (50 days). In a study on comparison of kits suckling once versus twice per day, Kovacs et al. (2003) reported that early weaning after the period of suckling twice caused poor growth that was compensated later in life. Nicodemus et al. (2004) and Tumova et al. (2002, 2006) reported a higher dry matter and crude protein digestibility in early weaned rabbits and a decrease as the age at weaning progressed. At this regard it seems appropriate to suggest the improved growth rate in early weaned rabbits was a result of the efficiency in utilization of solid feed. In a similar study, kits weaned at 14 days of age registered a lower feed intake as compared to their group mates weaned at 28 days of age resulting in poor growth (Ferguson et al., 1997). In guinea pigs which is also multiparous species early weaning allowed enough feeding for kids, which had a positive effect on growth rate as well as reducing mortality (Fonteh et al., 2005). Early weaning curtailed the requirement on the body reserves of dams. Despite the stress induced by early weaning, kits develop the scope to easily ingest solid and fibrous feed earlier in life. From a management stand point, the promotion of digestive capacity and existence of microbiota is enhanced by early provision of solid feed. This implies a primary advantage in feed conversion rate, which could be crucial to promote meat production. It is reasonable to suggest that weaned kits

should be fed as per their nutritional requirement depending on their stage of development or weaning age. In addition to stress factor and reduced growth, weaning age is associated with myriad of other threats. These include an explicit change from milk suckling to a solid diet that may contain dietary constituents that may not be easily digestible to kits. Dietary composition affected the evolution of kits digestive capacity, performance and subsequent viability (Gidenne and Fortun-Lamothe, 2002). This implies that dietary configuration may influence digestion and performance in early weaned rabbits. It seems later weaning is in no way beneficial other than for fryer production - very young rabbits which can be deposed of at 8-weeks and have not endured weaning shock. In addition, in a situation of poor quality and limited quantity of feedstuff it is desirable to wean rabbits late at about 40 days (FAO, 1997). The rabbits weaned late registered an improvement in live weight, but as age progressed there were little differences on market weight. Late weaning reduced mortality rates in growing kits, in addition to increased litter weight (Alfonso-Carrillo et al., 2014).

3. Weaning age and mortality

Weaning age cannot be ascribed as a distinct cause of mortality; in fact kits usually die from interaction effects of assorted possible agents of death. Apart from weaning age influence on mortality, there is an invariable threat from the environment, such as disease incidence, and from a range of other outside sources including the improper diet, poor housing condition and management practices which can increase mortality. Early weaned kits had a depressed growth rate at 32 days than those weaned at 28 and 32 days of age, however, both early and late weaned kits had a comparable weight at 56 days with no distinction in mortality (Trocino et al., 2001). In rabbits weaned at 14 and 32 days of age, Prudhon and Bel (1968) reported that early weaned growing rabbits apart from adapting well to dry feed compensated for live gain at 8 to 9 weeks of age and registered similar weights with those weaned at 32 days. However, rabbits weaned at 14 and 32 days did not differ in total mortality. In conformity, higher mortality was also observed in 14 day old kits compared to those weaned at 28 days of age. Rabbits reared traditionally and weaned at 21 days of age were reared and fed on a balanced non medicated diet registered a non-significant increase in mortality rate (Kovacs et al., 2003). The same author suggested that mortality rates were not affected by genetic groups and can be minimized by practicing good management, among which choice of weaning age is crucial. Mortality was higher in early weaned kits than those conventionally weaned (Feugier et al., 2006). These results agree with findings of Gidenne and Fortun-Lamothe (2001), despite that at 32 to 45 days of age a higher mortality during weaning stage was observed for early weaning. On the same note, Xiccato et al. (2003) reported that weaning age did not affect mortality rate. This partly agrees with the findings of Menzies (1959) studying the litters of dams with kits weaned at 4, 6 and 8 weeks observed a non-significant influence on mortality. Zita et al. (2012) working with Hyla hybrid rabbits observed higher mortality in kits weaned at 21 days of age (early weaning) than those weaned at 35 days of age (late weaning). The same author in different study with broiler rabbits had previously observed that weaning age had no impact on mortality rate (Zita et al., 2007). The inconsistence of result from different studies on the effect of weaning age on mortality is a major concern in rabbit production.

4. Weaning age and carcass and meat quality properties

Rabbits weaned at 21 days of age featured higher in hot carcass weight, chilled carcass weight and dressing percentage than those weaned at 35 days of age, however, higher drip loss was registered at 35 days of age (Zita et al., 2012). In a similar study, rabbits weaned at 28 days had improved dressing out percentage surpassing the rabbits weaned at 63 days (Marongiu et al., 2008). This is in contrast with observation made by Zita et al. (2007) who reported that dressing percentage was not influenced by weaning age. However, the effects of weaning age on dressing percentage was reported by Bivolaski et al. (2008) while comparing rabbits weaned at the ages of 25, 28, 31 and 35 days. 25 and 35 days of age at weaning gave the highest dressing percentage of 53.11 and 53.07%, respectively. Bivolarski et al. (2011) working with New Zealand White rabbits weaned at 21 and 35 days of age dressing percentage was lower in rabbits weaned at 21 days of age as compared to the 35 day weaned rabbits. It is important to note that dressing out percentage has a positive influence on carcass yield and is treated as a very important economic variable during marketing. On the other hand, pH and dry matter of the longissiumus lumborum were noticeable lower in 21 day weaned rabbits. Also pH of meat did not differ in early (28 days) and late weaned kits (Marongui et al., 2008). Weaning age influenced the water content, fat and dry matter in meat

(Bivolarski et al., 2014). However, meat properties such as water holding capacity and lightness were improved in 21 day weaned kits than the normally weaned kits (35 days). The author concluded that weaning age affected carcass parameters and physiochemical properties of rabbit meat. These results agree with the early findings of Zita et al. (2007) although contradictory to the findings of Mahunguane (2016). At the age of 35 days of weaning kits meat registered non-significant content of protein, fat and ash. In the same study, water holding capacity and pH had a negative correlation. Water holding capacity is critical in meat production in the sense that it influences water tissue retention and can also reduce meat pH. The improved dry matter and reduced water content of meat in rabbits weaned at 35 days was ascribed to increased body weight supported by high dressed carcass. In a similar study Vachkova (2008) observed that early weaned rabbits registered an accelerated growth rate, however, showed a depressed muscle build up compared to normal weaned rabbits.

5. Implication

From the literature cited, can conclude that choice of age at weaning will predominately influence performance, mortality, carcass and meat quality properties in rabbit production. The producer's major survival strategy in a competitive rabbit meat market is that management practices such as weaning age should reflect positively on the economics of the individual market by enhancing profitability. It is important to note that the positive early weaning observations on subsequent performance in growing rabbit studies were made possible due to the satisfactory interactive effects of weaning age and nutrition, in certain case improvements in housing. The magnitude of interaction of weaning age with other productivity and cost parameters during weaning differ hence it makes comparison of results for optimum weaning age from different studies and/or production systems difficult. The early weaned kits shows a more substantial slacken growth after weaning compared with those weaned late. This response was generally associated with a lower feed intake compared with the kits weaned at an older age, which may be a consequence of various considerations including an underdeveloped gastrointestinal system at this stage.

Disregarding the rabbit weaning age, it is important that the weaned kits ingestion of solids is done as soon as possible for the producer to maximize on subsequent growing and finishing performance as determined by individual markets. It is reasonable to suggest that the subsequent performance of early weaned kits will depend on adequate amount of nutrition appropriate for their stage of development. However, producers should not ignore the fact that it has been noted in other studies that with an increased weaning age, growth rate may be improved, while reducing mortality with a slightly better carcass lean percentage. It is seemingly likely to be true that the ultimate goal of choosing any weaning age in domestic rabbits should be to minimize stress in the dam through reducing the amount of time the growing kits suckle. Weaning process sets considerable environmental and social stresses on kits as they attempt to adjust to an unfamiliar environment and nature of solid feed. The producers' choice of age at weaning should aim at reducing nursing stress and accelerate the resurgence of estrous process in dams.

One of the limitations of most previous studies to ascertain optimum weaning age in rabbit production was that they principally focused on performance, mortality, carcass and meat quality properties, while disregarding the long term economic implications for weaning age on the enterprise. There was a tendency of assessing specific stages of production without taking into account the synergies in the entire system, especially the cost of production and profit margins as influenced by weaning age. From the viewpoint of enhanced productive traits, reduced mortality, improved carcass and meat quality properties within different production systems (intensive, semi-intensive and extensive system) it entails over and above, up to date knowledge and critical assessment of prevailing recommendations for weaning age in rabbit production. Such knowledge will make the degree of improvement in productive traits, mortality, carcass and meat quality properties be easily predictable within any specific rabbit production system. Prospective studies should quantify the impact of weaning age on throughput within different production systems taking into account the various interactive effects i.e. weaning age with genotype and feeding pattern. This move will also assist in increasing rabbit meat share in global and individual markets taking advantage of the new consumer perception of meat quality and demand for pro health meat. On the other hand, there should be a clear true betterment in throughput associated with choice of appropriate rabbit weaning age illustrating the significance of production systems to clearly rationalize weaning age and maximize economic returns. The adverse effects of weaning process can be reduced by choosing an appropriate age to wean

growing rabbits depending on the production system. This should be accompanied by weaning at acceptable body weight and feeding kits properly ahead of weaning.

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