FEED RESTRICTION AN INNOVATIVE CHALLENGE FOR THE PROFITABILITY OF RABBIT FARMING IN ALGERIA, A REVIEW

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Abstract

Recent research in rabbit farming has focused on studying the impact of proper nutrition on rabbits during the growing stage. This is done in a proposal to find an effective strategy to reduce health problems in animals during weaning, while also considering the technical and economic aspects of this type of farming. Our study aims to clarify the effects of different types and quantities of dietary restriction on rabbits and their performance, based on various studies and research that have addressed this topic. Therefore, this research serves as a comprehensive summary of previous studies on dietary restriction in rabbits during the fattening stage. The results of these studies demonstrate the effectiveness of dietary restriction as a strategy, which can be adopted to achieve the desired economic goals of markets and consumers, as well as health-related objectives and overall profitability in rabbit farming projects**.**

Keywords: Rabbit, feedrestriction, fattening, zootechnical performances**.**

LA RESTRICTION ALIMENTAIRE : UN ENJEU INNOVANT POUR LA RENTABILITÉ DE LA CUNICULTURE EN ALGÉRIE, REVUE

Résumé

La recherche récente en cuniculture s'est focalisée sur l'étude de l'impact d'une nutrition adéquate sur les lapins pendant la phase de croissance. Ceci dans le but de trouver une stratégie efficace pour réduire les problèmes sanitaires des animaux au sevrage, tout en tenant compte des aspects techniques et économiques de ce type d'élevage. Notre étude vise à clarifier les effets de différents types et quantités de restrictions alimentaires sur les lapins et leurs performances, en se basant sur diverses études et recherches qui ont abordé ce sujet. Par conséquent, cette recherche constitue un résumé complet des études antérieures sur la restriction alimentaire chez les lapins en d'engraissement. Les résultats de ces études démontrent l'efficacité de la restriction alimentaire en tant que stratégie, qui peut être adoptée pour atteindre les objectifs économiques souhaités par les marchés et les consommateurs, ainsi que les objectifs liés à la santé et la rentabilité globale des projets d'élevage de lapins.

Mots-clés : Lapin, restriction alimentaire, engraissement, performances zootechniques.

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Introduction

In Algeria, the rabbit farming sector can be classified into two distinct entities: on the one hand, a traditional sector made up of very small farms focused on food production, and on the other, a rational sector made up of large-scale units focused on marketing their products (Gacem and Lebas, 2000; Benabdelaziz et al., 2020).

The prospects offered by rabbit farming could potentially boost the country's economy. However, it is easy to conclude, based on data from the Ministry of Agriculture (MADRP, 2021), that its contribution is negligible, representing just 2% of rabbit and poultry production. It should be noted, however, that these values may underestimate the real impact, as studies conclusively demonstrate the positive effects of rabbit products, both industrially and in terms of public health.

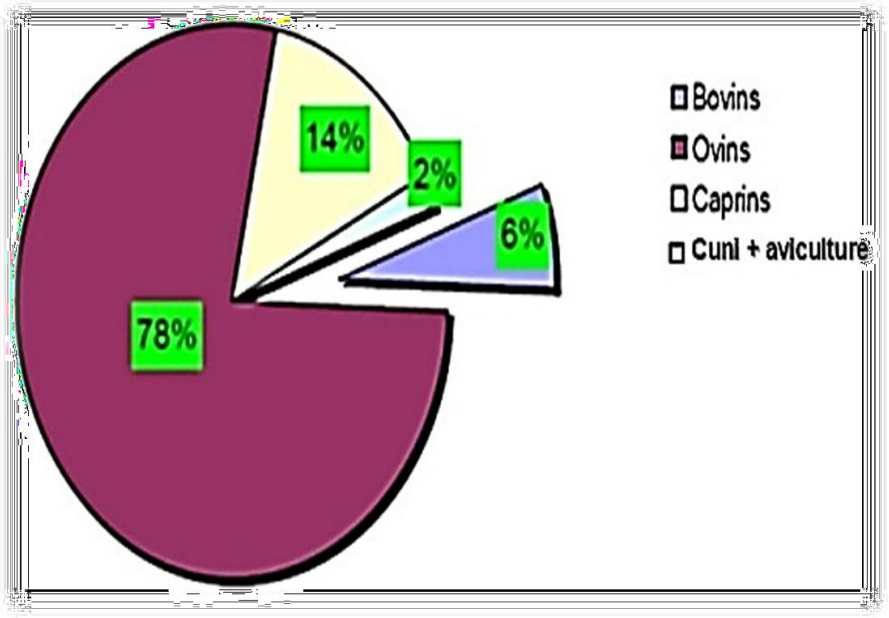

Fig. 1. Repartition of the different animal productions in Algeria (MADRP, 2021).

Feeding on rabbit farms accounts for approximately 70% of total costs. The nutritional requirements of rabbits, particularly during the growth phase, have been updated in a synthesis by Lebas (2004b) and Gidenne and Garcia (2006), recommending an intake of 2600 Kcal of digestible energy and a crude protein content of 16 to 17% to ensure optimal growth. Previous research studies, such as those by Lebas and Ouhayoun (1987) and Ouhayoun (1986), have long confirmed the impact of feed, both in terms of quantity and quality, on rabbit growth.

It is noted that rabbits adjust their food intake according to the energy concentration of their diet. Thus, a recommended balance between the various feed components, notably the protein/energy ratio and fiber content, is necessary to enable rabbits to fully express their growth potential (Lebas 2004b; Gidenne and Garcia, 2006). However, it should be pointed out that during this phase, the animal is subject to various digestive disorders linked to post-weaning feeding.

To minimize the incidence of digestive disorders in growing rabbits, several researchers have adopted the method of moderate feed restriction, limiting feed intake to 20% of a free-range diet. This approach has proved effective, contributing to a reduction in post-weaning mortality and morbidity, improving feed conversion and reducing carcass adiposity without compromising growth performance (Gidenne et al, 2012; Gidenne et al, 2013).

The aim of this study is to highlight the different feed restriction techniques practiced worldwide and in Algeria, assessing their impact on the performance of fattening rabbits.

Definition of restriction

Feeding restriction, recently discovered, is characterized by the temporary limitation of the quantities of food ingested by rabbits after weaning. This approach aims to reduce the frequency of digestive disorders, improve feed efficiency and reduce rejection. Indeed, this strategy is positioned as an effective means of reducing antibiotic use in rabbit farming, while also having a positive impact on the environment and the breeder's income (Gidenne, 2017).

Another definition of feed restriction involves the rationing of animals, particularly rabbits, which are restricted for twenty days after weaning, before then returning to ad libitum feeding. This approach has been extensively studied for around three decades (Jentzer, 2009).

Types of feed restriction

A distinction must be made between different types of feed restriction in rabbit farming. In general, animals have free access to pelleted feed (Ad Libitum = AL) and water (via automatic pipettes). Various techniques have been examined to control feed (or water) intake, with two main objectives: controlling carcass and meat quality (Perrier and Ouhayoun, 1996) and improving feed efficiency. Two restriction strategies have been widely used: quantitative intake restriction or qualitative restriction (Rebollar et al., 2011).

1- Qualitative restriction

Nutrient intake is modified through the chemical composition of the food. For example, to restrict energy intake in young breeding females, the use of fiber-rich feed can be favored (Rebollar et al., 2011).

In fact, rabbits adjust their intake according to the energy level of the food (Gidenne et al., 2010c), within a range of energy concentrations exceeding 9 MJ DE/kg, without substantial modifications to lipid or highly digestible fiber intake. Under these conditions, voluntary energy intake is correlated with the metabolic weight (MW, equivalent to live weight at power 0.75) of the animal (Xiccato, 1999), and oscillates between 0.9 and 1 MJ DE/kg MW (Xiccato, 2010).

Within this range, rabbits will consume more feed if it is less energetic.

2- Quantitative restriction

In practical terms, quantitative restriction can be implemented in three ways:

- By restricting access to drinking troughs.

- Reducing the amount of feed distributed.

- By limiting the duration of access to the feed trough. (Prud'hon et al., 1975).

2.1- Feed restrictionby limiting watering

Water restriction is characterized by a reduction in fluid intake, spread over a 24-hour period. In the case of the domestic rabbit, as in many other species, there is a close correlation between levels of solid food and drinking water consumption, although differences between individuals are observable, albeit appreciable.

According to the work of Cizek (1961), Prud'hon (1967) and Prud'hon et al. (1975), the quantity of water ingested is approximately twice that of dry matter consumed, but this may vary according to the age of the animal, its physiological state and climatic conditions. Observations frequently made on farms, particularly where watering systems are inadequate, indicate that rabbits subjected to water restriction show reduced feed intake and growth disturbances. However, these observations are rarely quantified.

Water restriction is positioned as an indirect method of restriction, offering an interesting alternative to quantitative restriction due to its effectiveness in reducing digestive disorders, notably its ease of implementation (Boisot et al., 2004; Verdelhan et al., 2004; Foubert et al., 2007, b; Ben-Rayana et al., 2009).

Pellet intake is directly linked to water consumption, and reducing watering time thus emerges as a simple and economical technique. For example, feed consumption is reduced by 18% when watering time is limited to 2 hours per day (Boisot et al., 2004), by 22% for 1 hour and 30 minutes (Verdelhan et al., 2004) and by 23% for 1 hour (Boisot et al., 2005). However, it should be noted that the application of significant water restriction raises questions about animal welfare, especially under hot climatic conditions (Foubert et al., 2007; Ben Rayana et al., 2009).

2.2- Feed restrictionby Reducing feed intake

To achieve precise control of post-weaning intake, the most accurate method is to administer a defined quantity of pellets daily, either manually or using an Automatic feed Distribution (AFD) system now widely adopted in rabbit farming.

During the growth phase, several restriction programs are possible, such as progressive or non-progressive intake reduction, stepwise reduction, or continuous or alternating restriction (Yakubu et al., 2007).

The most commonly used method for limiting feed intake (60-90% of breeders) is to reduce a defined percentage of the feed intake in relation to the voluntary theoretical feed intake (Gidenne et al., 2012b).

2.3- Feed restrictionby limiting feeder access time

The technique of restricting access to the feeder can be implemented on a daily basis, by reducing the number of hours of access to the feeder, or on a weekly basis, thus offering another means of limiting intake. For example, it is possible to reduce intake by 20%, or 80% of free access (FA), by maintaining free access to the feeder for 5 days followed by a 2-day fast (Lebas and Laplace, 1982).

A similar level of 80% free intake can also be achieved by limiting access to the feed trough to 8 hours per day (Jérôme et al., 1998; Szendrő et al., 1988).

According to Jérôme et al. (1998), if feed is available only during the day (from 08:00 to 16:00 h), intake is reduced by 20% (and growth by 12%), whereas if feed is available at night (from 16:00 to 8:00 h), intake is reduced by only 10%, with growth reduced by 5%. At the same time, the Consumption Index (CI) was only improved when the feed was available during the day (2.67 vs. 2.93 for AL).

On the other hand, daily restriction of feeder access time produced results similar to those observed with a quantitative reduction in distribution (Jerome et al., 1998; Salaün et al., 2011) and is advocated by some feed manufacturers to preserve health while improving profitability.

The effect of dietary restriction

1- On growth

Feed restriction is implemented in growing females to prevent excessive weight gain and avoid subsequent reproductive disorders (Rommers et al., 2004). Although restricted feed intake reduces growth rate, it can also

compromise slaughter yield (Gidenne et al., 2009b; Briens et al., 2011).

Growth is affected by feed restriction, which naturally reduces growth rate. However, this reduction is not directly proportional to the reduction in feed intake. For example, a 20% reduction in intake results in an average 15.6% reduction in growth (Gidenne et al., 2012b). Other factors, such as feed composition or the general health of the animals, can also influence growth.

When animals return to ad libitum feeding, significant compensatory growth can be observed, accompanied by a slight overconsumption compared to animals fed ad libitum since weaning (Gidenne et al., 2012b; Szendro et al., 2010). However, this compensation does not fully offset the growth retardation induced by feed restriction, ultimately leading to a marked improvement in feed efficiency (Gidenne et al., 2009b; Perrier, 1998).

In Algeria, the study reported by Saidj et al. (2023) revealed relatively modest daily body weight gains and live weights at 12 weeks of age, characteristic of the unselected local rabbit population. These results are consistent with several previous studies on this rabbit genotype (Berchiche et al., 1996; Kadi et al., 2004; Moula et al., 2013).

The negative effect of feed restriction, resulting from limited access to the feeder on weight growth during the second half of the restriction period, is compensated for during the ad libitum refeeding phase (10-12 weeks). This compensation stems from the phenomenon of compensatory growth, as reported in similar cases by Tůmová et al. (2022b) and more recently by Birolo et al. (2020 and 2021). It is well established that restricted feeding of rabbits improves nutrient digestibility, induces compensatory growth and increases feed efficiency during the period of restricted feeding (Tůmová et al., 2006; Gidenne et al., 2012).

The results of Tůmová et al. (2007) and Matics et al. (2008) indicate that the intensity of compensatory growth is related to the duration of periods of restricted access to feeders. This effect is consistently observed when rabbits are reintroduced freely to the feeder after the restricted period, as in the study by Birolo et al. (2021).

2- On feed efficiency and feed conversion ratio

The unfavorable impact of feed restriction on rabbit growth has positive repercussions on feed efficiency and feed conversion, even if this results in moderate growth. Despite limited growth, the animals manage to optimize the use of the feed distributed more efficiently (Gidenne et al., 2009c).

A reduction in feed intake of the order of 20% translates into a 5-10% improvement in feed efficiency, while a 25% reduction in feed intake shows significant variations depending on the study (Gidenne et al., 2012b). Alongside growth, feed efficiency is strongly influenced by the nutritional composition of the feed. On commercial farms, breeders generally observe an improvement in feed conversion of 0.1 to 0.2 points (Lebas, 2007).

Saidj et al (2023) reported that reducing the daily feeding time to 3 hours per day for 5 days per week for 5 consecutive weeks resulted in a significant reduction in daily feed consumption of around 36%, without however influencing the feed intake index. This highlights the beneficial effects of restriction on the feed efficiency of fattening rabbits.

These results demonstrate the value of temporary intake restriction in reducing feed consumption.

3- On the health of growing rabbits

The work of Boisot et al. (2003) and Gidenne et al. (2003) demonstrated the preventive efficacy of a feed restriction of at least 20%, which significantly reduced mortality and morbidity rates, particularly in the context of rearing in a restricted environment (EEL) or, more generally, in the event of non-specific digestive disorders.

In an experimental setting, a reduction in feed intake of over 20% compared with free-range feeding led to a reduction in post-weaning mortality and morbidity of around half (Gidenne et al., 2009b). However, this reduction remains variable, and its link with feed quality remains insufficiently explored. An in-depth understanding of the underlying physiological mechanisms and their interactions with feed nutritional values could help optimize feed restriction strategies.

On commercial farms, where the levels of restriction applied are often less stringent than in experimental settings, a reduction in mortality of the order of 2 to 3%, and even 7% in some cases, has been observed, corresponding to a one-third reduction in mortality (Lebas, 2007). During the period of feed restriction, digestive efficiency is improved, and this improvement is even more pronounced when rabbits are subsequently fed freely, thanks to significant compensatory growth (Gidenne et al., 2012).

Although most studies indicate a beneficial effect of restriction on digestive health, the magnitude of this effect varies considerably from study to study. This variation depends on the intensity of the restriction, its duration of application, the specific health conditions and pathologies encountered, and the chemical composition of the food (Lebas, 2007).

4- Economic and ecological aspects of feed restriction

In economic terms, the application of feed restriction strategies offers an opportunity to increase profitability by improving animal health and optimizing feed conversion. Reduced health problems, such as mortality and morbidity, combined with reduced or even eliminated medication use, contribute to lower veterinary costs. At the same time, reduced CI translates into lower feed costs. It's worth noting that feed is the main expense item on a farm, accounting for 53% of the selling price of a rabbit in 2012 (Coutelet, 2012). This factor is becoming increasingly important as the price of raw materials, particularly feed, rises (Coutelet, 2012).

Martignon (2010) estimated that limiting feed intake improved the margin on feed costs by around 23 euro cents per rabbit, based on 2008 economic data. An integrated analysis of two Groupe d'Expérimentation Cunicole (GEC) trials (Knudsen et al., 2014; Knudsen et al., 2015a) has made it possible to assess more precisely the economic impacts of a strategy involving 4 weeks of 25% restriction, followed by one week of free feeding. This approach proved particularly beneficial under unfavorable health conditions (€0.13/kg vs. €0.03/kg), while under favorable health conditions, although the margin was numerically higher (€0.27/kg vs. €0.25/kg), it remained similar with or

without restriction. These results underline the economic interest of a restriction strategy under difficult sanitary conditions, while at the same time constituting an economically viable preventive measure under favorable sanitary conditions. It should be noted that drug expenditure was not measured in this estimate, suggesting an underestimation of the benefit of restricting ingestion, given that Lebas (2007) estimates the reduction in drug expenditure at 15 eurocents per Artificial Insemination (AI). The additional cost of implementing feed restriction, such as labor time or the installation of an automatic feeding chain, remains a major concern. The additional cost of implementing dietary restriction, such as labor time or the installation of an automatic feeding chain, also remains to be assessed.

From an ecological point of view, in the context of the search for sustainable breeding systems, it has been shown that feed and effluents are the main contributors to environmental impacts. Restricting feed intake can help reduce these two aspects (Gidenne et al., 2011). A life cycle assessment showed a reduction in environmental impacts (11% reduction in eutrophication potential, 12% reduction in acidification and 10% reduction in agricultural land use in particular) with feed restriction strategies, mainly due to improved system efficiency (Zened et al., 2013).

Conclusion

The critical period for digestive disturbances is the first two weeks post-weaning. It would therefore be conceivable to apply a strategy of feed restriction during this period only, with a return to more prolonged ad libitum feeding to promote growth and slaughter performance, and probably better and faster compensation

Feeding restriction in fattening rabbits is a very effective strategy; whatever the method used, (qualitative orquantitative)which can:

- improve the growth and feed efficiency

- Reduce the frequency of pathologies

- Reduce carcass fat content.

- Reduce mortality and morbidity

- Increase carcass yield and meat quality

- Maintain body weight to ensure correct reproductive performance in adulthood

Finally better economic profitabilityand social and ecological returns in terms of consumer health.

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