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Review on Egg Handling and Management of Incubation and Hatchery Environment

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ABSTRACT
Poultry egg incubation and hatchery managements are critical aspects of the poultry industry that require careful attention to ensure optimal hatchability rates and chick quality. Despite advances in technology and management practices, low hatchability rates and poor chick quality remain significant challenges. This review aims to discuss the methods of incubation and hatchery management, with a focus on natural and artificial incubation methods. The review found that both natural and artificial incubation methods have their advantages and disadvantages. Natural incubation is less expensive but requires more time and effort, while artificial incubation is more efficient but requires more investment. Multi-stage incubators are more efficient than single-stage incubators, but they require more complex management. Hatchery requirements and management are crucial for successful hatches. Proper hatching egg management, incubation environment and operations in artificial incubation are important factors that affect hatchability. Factors such as temperature, humidity, ventilation and turning should be closely monitored to ensure optimal hatchability. The review also emphasizes the importance of the hatchery building. The hatchery building should be designed to provide a suitable environment for egg hatching. Factors such as insulation, ventilation, lighting and hygiene should be taken into consideration when designing a hatchery building. In conclusion, proper incubation and hatchery management are essential for successful hatches and increased productivity.

KEYWORDS
Chick quality, hatchability, hatchery building, hatchery management, incubation environment, incubation

INTRODUCTION
Poultry egg incubation and hatchery managements are critical aspects of the poultry industry that require careful attention to ensure optimal hatchability rates and chick quality[1,2]. Incubation is the process of artificially or naturally maintaining eggs at a specific temperature and humidity level to stimulate embryonic development and hatching. Hatchery management involves all the activities associated with the handling, storage, incubation, hatching and rearing of chicks[3,4]. According to the findings of Dvořák *et al.*[5] the successful incubation and hatching of eggs depend on several factors, including the incubation method, hatchery requirements and management, incubation environment and hatchery building design.

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Despite the advances in technology and management practices in the poultry industry, low hatchability rates and poor chick quality remain significant challenges for hatchery operators. Several factors contribute to low hatchability rates, including poor egg handling practices, inadequate incubation environment and suboptimal hatchery building design. Therefore, there is a need for a comprehensive review of the literature on incubation and hatchery management to identify the gaps in knowledge and best practices that can be implemented to improve hatchability rates and chick quality[6,7].

Multi-stage incubation systems improved hatchability rates and chick quality compared to single-stage incubation systems[8]. Proper hatchery building design and layout were critical for maintaining optimal environmental conditions for hatching eggs and raising chicks[9]. The importance of proper egg-handling practices, disinfection and fumigation in improving hatchability rates[10]. To prevent cross-contamination and maintain a hygienic environment emphasized the need for proper room separation and ventilation in the hatchery building[11].

Despite the significant progress made in poultry egg incubation and hatchery management, several gaps in knowledge and best practices remain. For instance, there is a need to identify the most effective incubation method for different types of poultry eggs[12]. Additionally, Nwagu[6] stated that there is a need to develop best practices for egg handling, storage, disinfection and fumigation to improve hatchability rates. Furthermore, there is a need to identify the optimal environmental conditions for egg incubation and chick rearing. Finally, there is a need to develop best practices for hatchery building design and layout that promote optimal environmental conditions for hatching eggs and raising chicks[7,13].

Therefore, this review article aims to identify the gaps in knowledge and best practices in poultry egg incubation and hatchery management. The review will provide an overview of the current state of knowledge in this field and identify best practices that can be implemented to improve hatchability rates and chick quality[5,6,14,15]. It provides a comprehensive overview of poultry egg incubation and hatchery management. Specifically, the review aims to identify best practices for egg handling, storage, disinfection and fumigation, determine optimal environmental conditions for egg incubation and chick rearing develop best practices for hatchery building design and layout and provide recommendations for improving hatchability rates and chick quality in the poultry industry.

LITERATURE REVIEW

Method of poultry egg incubation: Poultry egg incubation is a process that involves hatching eggs using either a broody hen or an incubator machine. Natural incubation is a traditional method that involves using a broody hen to sit on and incubate eggs. Signs of broodiness include the hen sitting on the eggs for long periods, plucking feathers from her breast to create a warm nest and becoming aggressive toward other chickens[16,17]. On the other hand, artificial incubation involves the use of special equipment to incubate eggs. Incubators are generally divided into several types or categories based on how they operate and whether they are used for single or multistage incubation. Multi-stage incubators (MI) are used for large operations that require a fixed number of birds every week can be cited as[18,19]. These machines incubate eggs at different stages of development in the same cabinet. Single-stage incubators (SI), on the other hand, are used by operations that require varying numbers of chicks hatched from day to day and week to week. They are designed to incubate eggs that are all at the same stage of development[20,21].

Hatchery requirements and management: Effective hatchery management is essential to producing high-quality chicks for commercial and backyard poultry operations. The process involves ensuring the quality of hatching eggs, proper sanitation, storage and selection of eggs for incubation. Proper hatchery management requires careful attention to detail and adherence to best practices in egg collection, sanitization, storage and selection of eggs for incubation[18,22,23].

Hatching egg management: According to the findings of Adriaensen *et al*.[22], hatching egg management involves egg collection, sanitization, storage and selection for incubation.

Collection of hatching eggs: The frequency of hatching egg collection is crucial to maintaining egg quality, especially in extreme weather conditions. Eggs should be collected a minimum of four times per day from conventional nests. In mechanical nests, the belt should run almost continuously in the morning since most eggs are laid during this time. The belt should also run at mid-afternoon and finally at 5:00 pm to collect the remaining eggs[21,23].

Sanitizing hatching eggs: Sanitizing hatching eggs is essential to reduce the risk of bacterial contamination and improve hatchability rates. There are several methods for sanitizing hatching eggs, including fumigation, spray, washing, immersion and mechanical spray[23,24].

Egg storage: Proper storage of hatching eggs is critical to maintain their quality before incubation. Hatching eggs should be stored in a specially designed egg storage room that prevents pre-incubation embryonic development after egg collection[22]. The temperature inside the storage room must be adjusted based on the duration of storage. Storage temperature for a few days is 18°C while for one week or longer duration, the storage room temperature must be reduced to 13°C. The relative humidity in the storage rooms should be maintained between 75 and 80%[24,25].

Temperature: Temperature regulation is crucial in egg storage as it affects the rate of moisture loss through shell pores and can impact the viability of embryos. The temperature inside the storage room must be adjusted based on the duration of storage[22,24,26].

Humidity: The relative humidity is an essential factor in egg storage since it affects the rate of moisture loss through shell pores. The relative humidity in the storage rooms should be maintained between 75 and 80%[23,24,27,28].

Positioning and turning eggs: The way in which an egg is placed in the egg trays (egg orientation) is crucial in egg storage since it can affect hatchability rates. Eggs stored for less than ten days should be stored with the large end up position while eggs stored for ten days or more should be stored with the small end up position to improve hatchability rates[25,29,30].

Hatching egg selection: Effective hatching egg selection is critical in producing high-quality chicks for commercial and backyard poultry operations. The objective of egg selection is to eliminate eggs that are less likely to hatch and produce quality chicks. Eggs with defects such as excessively long, thin shells, completely round eggs, wrinkles, hairline cracks, toe-punches, pointed ends, dark tops (rough areas) and calcium deposits should be eliminated as they reduce hatchability rates[17,31].

In conclusion, proper hatchery management is essential in producing high-quality chicks for commercial and backyard poultry operations. Hatchery management involves ensuring the quality of hatching eggs, proper sanitation, storage and selection of eggs for incubation. Effective hatchery management requires careful attention to detail and adherence to best practices in egg collection, sanitization, storage and selection of eggs for incubation[2,21].

Incubation environment: The incubation environment plays a vital role in the artificial incubation process, as it is critical for producing high-quality chicks. To ensure successful artificial incubation, the incubator environment should meet four essential requirements, including temperature, relative humidity, ventilation and turning, as noted by various researchers[19,21,22]. This review will provide a detailed discussion of each of these factors.

Temperature: Temperature is the most critical environmental factor during incubation because the developing embryo can only tolerate very small fluctuations in temperature during the incubation period[18]. The recommended temperature ranges for setters and hatchers (incubators set temperature) are 37.2 to 38.2°C during the first 18 days (setter phase). For the last three days (hatcher phase), the temperature is lowered to between 36.0and 36.5°C[21]. The optimal temperature range for embryonic development in chickens is between 37.2 and 38.6°C[5,22,32].

The temperature should be maintained at a consistent level throughout the incubation period, with a slight decrease during the hatching phase. Deviations from the optimal temperature range can lead to reduced hatchability, poor chick quality and increased embryonic mortality[22,23,30]. The recommended set temperatures for both setters and hatchers may vary depending on the incubator manufacturer. The temperature of the embryo is equally important as the incubator's set temperature. The optimum embryo temperature range is between 37.2 and 38.6°C[18]. For the first 10 days of the incubation period, the embryo temperatures should be near the lower end of the optimum range (37.2°C). For the remaining period (11-21 days), the embryos' temperature should be near the upper end (38.6°C) of the optimum range[5,22,32].

Relative humidity recommendations: Relative humidity (RH) determines the rate of moisture loss from eggs during incubation. Low relative humidity can cause egg contents to dry out too rapidly, leading to reduced hatchability rates and producing smaller than normal chicks (poor-quality chick) that will not perform well during the brooding period[27]. For the first 18 days, most incubator manufacturers recommend relative humidity between 55 and 65%. After transfer to the hatcher, the relative humidity requirements increase to about 70%. At pipping and hatching, the relative humidity increases (the last day of incubation) to about 75-80%[21,29]. The relative humidity is an important factor that affects egg development and hatching. The optimal relative humidity range for incubation is between 50 and 60% during the first 18 days and between 65 and 75% during the hatching phase[22,30]. Proper humidity levels are essential for maintaining the correct moisture balance in the egg, which is critical for embryonic development and hatchability[19,22]. The most accurate method of adjusting humidity is to monitor the weight loss of eggs. Hatching eggs weighing 56.7 g with good shell quality should lose 12% of their weight during the first 19 days of incubation[25,27,29,33].

Position of eggs and turning: The position of eggs and turning are critical factors in artificial incubation that affect embryonic development and hatchability. When eggs are placed in the egg trays, the egg orientation and how the egg trays move are crucial to producing high-quality chicks[17,21,29]. When positioned larger end up, more than 90% of the embryos will have their heads near the large end of the egg near the air cell. In contrast, when positioned small end up, 60% of the embryo will develop with their heads near the small end, which can cause problems during hatching[25,29]. The practice in commercial hatcheries is to set eggs in a large end-up position and rotate them back and forth along their long axes for turning, which prevents developing embryos from adhering to the shell membrane and reduces embryo mortality[16,22].

Egg turning is another essential factor that affects embryonic development and hatchability. Turning the eggs several times a day helps prevent the embryo from sticking to the shell membrane, which can lead to deformities or death. The optimal tuning frequency is every one to two hours during the first 18 days of incubation[2,19]. After day 18, eggs should be left undisturbed until hatching. Most large incubators automatically turn the eggs through a 45° arc every 1 to 3 hrs, which is important for the first 18 days of the incubation period. The turning process should be completed quickly, allowing the eggs to remain stationary until the next turning[26,34].

Ventilation: Ventilation is another critical factor in artificial incubation since it allows free movement of air through the pores of the shell and shell membranes, which is important for a constant supply of oxygen and the elimination of carbon dioxide and moisture[22,23]. Fresh air contains 21% oxygen at sea level, which is also the optimum oxygen concentration for developing embryos. For each 1% decline in the oxygen content of the air, hatchability will drop by 5%. Poor ventilation (insufficient air exchange) increases the concentration of CO_2 in the incubator (setter and hatcher), which can be lethal for developing embryos[33].

Young embryos have a lower tolerance level to CO_2 than older ones and this tolerance level seems to be linear from day 1-21 day. Hatching chicks give off more CO_2 than embryos in eggs and devices are available for measuring the CO_2 content of the air. The best place to measure CO_2 is the exhaust ducts (outlets) of the setter and hatcher since measurements taken inside the machines are not as accurate since opening doors will change the environment inside machines[16,22]. As reported by Adriaensen *et al.*[22], ventilation rate should be adjusted according to the age of the developing embryo. For example, during the first week of incubation, the ventilation rate should be low, while during the 2nd week, it should be gradually increased to a maximum rate during the third week. The ventilation rate should be decreased during the hatching period to maintain high relative humidity levels[16,22]. In conclusion, the incubation environment is a critical factor in artificial incubation and each of its components, including temperature, relative humidity, egg position, turning and ventilation, should be carefully monitored and adjusted to produce high-quality chicks.

OPERATIONS IN ARTIFICIAL INCUBATION

Traying eggs: Artificial incubation involves various operations that must be carried out correctly for successful hatchery operations[21,22]. One of the critical operations is traying eggs, which involves placing eggs on setter trays. An efficient method is to place collected eggs directly onto plastic setter flats. It is also essential to make a flock identification that contains the necessary information and cards can be color-coded for easy identification[8,17,19,34].

Pre-warming and setting: Another operation in artificial incubation is pre-warming and setting. Pre-warming involves holding eggs in a room that is warmer than the egg holding room but cooler than the incubator(s). The duration of holding is typically between 4 to 12 hrs and it helps reduce the cooling effect the freshly set eggs have on eggs in the incubator[5,23,32,35]. Setting involves setting the time and date, the number of eggs to be set and careful attention should be given to the management of incubators for 21 days. The incubator must be visited at regular intervals to watch the temperature and relative humidity[2,20,30,36].

Candling: According to the results of Fouad *et al.*[33] investigation candling is another operation in artificial incubation that involves examining incubated eggs with light to determine their internal conditions. Candling helps determine the presence of an embryo, the developmental stage of the embryo and the presence of contamination, among others. On the other hands Brand *et al.*[37] study suggests that, candling can be done as early as 5 days of incubation, but most hatcheries candle on the 18th day of the incubation period together with the transfer of eggs to the setter unit. The method of candling can be done using a table candler (mass candler) or a spot candler. Candling should be able to distinguish three distinct classes, living normal healthy embryos, infertile eggs and early-dead embryos. To prevent too much cooling down during candling, eggs should not stay outside the incubator for more than 20 min. After candling, egg transfer to the hatcher is done[25,29].

Adjustment of basic incubation environment: Egg turning is another important operation in artificial incubation that affects embryonic development and hatchability. Turning the eggs several times a day helps prevent the embryo from sticking to the shell membrane, which can lead to deformities or death[16,22]. The optimal turning frequency is every 1 to 2 hrs during the first 18 days of incubation. After day 18, eggs should be left undisturbed until hatching[2,21]. Most large incubators automatically turn the eggs through a 45° arc every 1 to 3 hrs, which is important for the first 18 days of the incubation period. The turning process should be completed quickly, allowing the eggs to remain stationary until the next turning[18,19,37].

Maintaining proper temperature and relative humidity is crucial for successful artificial incubation. Temperature should be maintained at around 37.5°C (99.5°F), while relative humidity should be between 50-60% during incubation[5,30]. However, during hatching, relative humidity should be increased to around 70% to prevent chick dehydration. Monitoring temperature and relative humidity should be done regularly using calibrated thermometers and hygrometers[26,29,34].

Ventilation is another critical operation in artificial incubation that ensures proper oxygen supply and carbon dioxide removal from the incubator[23,33]. Proper ventilation also helps remove excess heat and moisture from the incubator. Ventilation can be achieved through natural or mechanical means. Natural ventilation involves opening windows or doors, while mechanical ventilation involves using fans or air ducts[3,35]. Sanitation is also crucial in artificial incubation to prevent contamination of eggs and chicks. Proper sanitation involves cleaning and disinfecting all equipment used in artificial incubation regularly. The egg holding room, setter room and hatcher room should also be kept clean and disinfected regularly[12,17,32].

In conclusion, proper management of operations in artificial incubation is essential for successful hatchery operations. These operations include traying eggs, pre-warming and setting, candling, egg turning, maintaining proper temperature and relative humidity, ventilation and sanitation. Adhering to the best practices in each of these operations will help ensure high hatchability rates, producing healthy chicks for commercial purposes.

FACTORS AFFECTING HATCHABILITY

Hatchability is a critical aspect of poultry production, as it determines the number of chicks that will hatch from fertile eggs. Hatchability (h) is influenced by various factors, including fertility, egg handling, incubation process, nutrition and breeder flock management[38-41]. The hatch of all egg's set value is determined by fertility and the success of the incubation process. Therefore, it is essential to optimize each of these factors to achieve high hatchability rates.

Breeder flock management is a crucial factor that affects hatchability. The health, nutrition, breed, age and flock management practices of the breeder flock can influence the fertility and hatchability rates of their eggs. Proper nutrition, vaccination and disease prevention practices are essential for maintaining a healthy breeder flock. The breed and age of the birds also play a role in hatchability rates, with younger birds generally producing more fertile eggs[2,19,31].

Based on Abioja *et al.*[17] research, egg handling is another critical factor that affects hatchability. Egg collection and storage practices can influence the quality of the eggs and their hatchability rates. Eggs should be collected frequently to prevent eggs from sitting too long in the nest and becoming contaminated. Dirty or cracked eggs should be removed from the hatchery to prevent contamination of other eggs. Eggs should also be stored in a cool, dry environment to prevent moisture loss and bacterial growth[22,29,30,34].

The incubation process is perhaps the most critical factor affecting hatchability rates. According to the results of Boleli *et al.*[19] investigation, temperature, turning, humidity, ventilation and sanitation of the incubator all play a role in determining hatchability rates[19]. The temperature should be maintained at around 37.5°C (99.5°F) during incubation, with fluctuations of more than ±0.5°C being detrimental to embryonic development[5,30]. Turning the eggs several times a day helps prevent the embryo from sticking to the shell membrane, which can lead to deformities or death. The optimal turning frequency is every one to two hours during the first 18 days of incubation. Relative humidity (RH) should be between 50-60% during incubation but increased to around 70% during hatching to prevent chick dehydration. Proper ventilation helps remove excess heat and moisture from the incubator and ensures proper oxygen supply and carbon dioxide removal. Sanitation practices are also crucial in preventing contamination of eggs and chicks[17,23,32].

In conclusion, optimizing factors that affect hatchability rates is essential for successful poultry production. Breeder flock management practices, egg handling procedures and proper incubation processes are all critical for achieving high hatchability rates. By maintaining a healthy breeder flock, collecting and storing eggs correctly and carefully monitoring incubation conditions, producers can maximize their hatchability rates and produce healthy chicks for commercial purposes.

HATCHERY BUILDING

The hatchery building is a critical component of any poultry production system and its dimensions are dependent on the number and size of machines to be accommodated. Additionally, the quantity of chicks that need to be hatched during a specific time frame also impacts the size of the hatchery building. Separate rooms should be provided for various functions such as the office, fumigation, egg grading, egg holding, setters (incubators), hatchers, chick grading and boxing, chick holding, supplies and waste disposal[2]. The importance of proper room separation cannot be overstated, as it helps to prevent cross-contamination and maintain a hygienic environment. Proper room design and layout can also help to reduce the risk of disease transmission among chicks[19,22]. The hatchery building should be designed to accommodate the number of chicks to be produced in a given period and should also provide adequate space for the machines and equipment required for the production process[2,19].

The egg receiving room is a crucial element of the hatchery building and should be situated at the entrance of the hatchery premises. It is where the eggs from the breeder farm are received, preferably through a window. To avoid the introduction of pathogens, individuals bringing in the eggs should not be allowed to enter the hatchery building[21,30]. The egg receiving room should also be designed to prevent contamination of eggs during transportation and handling[42]. Proper ventilation and temperature control are also essential in this room to maintain optimal environmental conditions for egg storage[22].

The disinfection, fumigation and holding room should be connected to the egg receiving room and after disinfection, eggs may be shifted to the cold storage/holding room. The egg holding room should be connected to the fumigation room. Proper ventilation is essential in these rooms to maintain optimal environmental conditions for egg storage and disinfection[22]. The fumigation room should be equipped with an appropriate fumigant that can effectively eliminate pathogens and pests from the eggs. The holding room should also be designed to ensure that eggs are stored at the appropriate temperature and humidity levels[22]. The use of automatic turning egg-turning machines can help to improve hatchability rates by ensuring that eggs are turned at regular intervals[29,38].

The egg sitting room is another crucial aspect of the hatchery building and must be spacious enough to allow easy movement around the setters. Adequate lighting is necessary in this room to ensure that the eggs are appropriately candled for internal egg quality before being placed into the incubators located in the sitting room[2,21]. The candling room must be kept dark and connected to both the egg setting and hatching rooms. It should also be equipped with fertility testing lamps or a mass candler. According to

Andrianova *et al.*[41] candling is an essential step in the hatching process that helps to identify infertile or dead embryos. The use of advanced technologies such as computerized egg handling systems can help to improve hatchability rates by reducing human errors during the handling process[29,34].

The hatching room is a crucial part of the hatchery building and hatchers should preferably be kept in a separate room. This part of the building should be ideally cleaned and well-ventilated to maintain proper environmental conditions for hatching. Ventilation systems should move air from clean areas to dirty areas in the same direction as hatching eggs move from setters to hatchers[22,35]. The hatching room should also be equipped with a backup generator in case of power outages. The use of advanced technologies such as multi-stage incubation systems can help to improve hatchability rates by providing optimal environmental conditions for embryo development[5,34]. The hatching room should also be designed to ensure that chicks are protected from predators such as rats and mice[21].

The chick sexing room may be attached to both the hatching and chick holding rooms. It should be equipped with an appropriate light source for chick sexing, such as a 200-watt electric bulb in a reflector[2,21]. Proper lighting is essential in this room to ensure accurate sexing of chicks. The chick holding room's size is based on the maximum number of chicks processed daily and its required size is also influenced by the extent of processing planned for the chick room. Adequate space should be provided to accommodate all chicks stored in the chick room at any given time. Proper ventilation is essential in this room to maintain optimal environmental conditions for chick growth and development[2]. The chick holding room should be designed to prevent overcrowding, as overcrowding can lead to poor air quality and increased risk of disease transmission[2]. The use of automatic watering and feeding systems can help to improve chick health and reduce labor costs[23,31].

In conclusion, proper planning of the hatchery building's design and layout is critical for maintaining optimal environmental conditions for hatching eggs and raising chicks. Separate rooms should be provided for various functions such as egg receiving, disinfection/fumigation/holding, egg setting, candling, hatching, chick sexing and chick holding. Proper ventilation and lighting are essential in each room to maintain optimal environmental conditions for egg hatching and chick growth and development. The use of advanced technologies such as multi-stage incubation systems, automatic egg turning machines, computerized egg handling systems and automatic watering and feeding systems can help to improve hatchability rates and chick health and reduce labor costs.

To improve hatchability rates and chick quality, it is recommended that hatchery operators implement best practices for egg handling, storage, disinfection and fumigation. The optimal environmental conditions for egg incubation and chick rearing should also be identified and maintained. Hatchery building design and layout should be optimized to promote optimal environmental conditions for hatching eggs and raising chicks. It is also recommended that further research be conducted to identify the most effective incubation method for different types of poultry eggs and to develop best practices for hatchery management. By implementing these recommendations, hatchery operators can improve hatchability rates and chick quality, leading to a more successful and profitable poultry industry

CONCLUSION

The successful incubation of poultry eggs and the quality of chicks produced are pivotal components of the poultry industry. Hatchery management and egg incubation require meticulous attention to detail. This review article provides an overview of current knowledge and best practices for enhancing hatchability rates and chick quality. Natural and artificial incubation are two distinct methods of incubation. Proper egg handling practices, disinfection and fumigation are essential in improving hatchability rates in artificial incubation. Multi-stage incubators have been found to enhance hatchability rates and chick quality compared to single-stage incubators. The optimal environmental conditions for egg incubation and chick rearing should be identified to ensure successful hatching. The egg receiving room, disinfection, fumigation and holding room, egg setting room, candling room, hatching room, chick sexing room and chick holding room are all essential components of the hatchery building. The hatchery building design and layout play a vital role in maintaining optimal environmental conditions for hatching eggs and raising chicks. In general, implementation of best practices for egg handling, storage, disinfection and fumigation, identifying optimal environmental conditions and optimizing hatchery building design can improve hatchability rates and chick quality. Further research is needed to identify the most effective incubation method for different types of poultry eggs.

SIGNIFICANCE STATEMENT

The purpose of this review is to discuss the methods of incubation and hatchery management in the poultry industry and identify best practices that can be implemented to improve hatchability rates and chick quality. The review found that both natural and artificial incubation methods have their advantages and disadvantages and multi-stage incubators are more efficient than single-stage incubators but require more complex management. Proper hatching egg management, incubation environment and operations in artificial incubation are important factors that affect hatchability. The review emphasizes the importance of the hatchery building and provides recommendations for improving hatchability rates and chick quality in the poultry industry. The key findings suggest that proper incubation and hatchery management are essential for successful hatches and increased productivity.

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