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OSTRICH BREEDING IN CHINA

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ABSTRACT: Ostrich (Struthio camelus) has become one of the valuable agricultural enterprises in many countries of the world. China has become Asian's number one ostrich species raiser with about 20,000 ostrich bred farms. China started in 1992 to import some ostrich species from South Africa. Ostrich was raised globely since the 1980s for its feathers, meat, egg, hair and bone are all of high economic value. China's progress in producing ostriches has improved it's rank from fifth to the second globely in recent years, due to the following factors: The area of pastures which reached 40% of the area of China.Large amounts of agricultural wasts. China has been producing iron and thus has produced the cheapest agricultural machines, such as irrigation machines, cutting and pressing the feed. China achieved progress in the electronical industries which have enabled it to produce hatchery machines to promote the poultry industry. China is making use of solar energy and producing cheap energy used to irrigate agricultural land and operate farm machinery. Thus, the price of feed is cheap and therefore it costs to feed the ostriches as little as possible.Use of seawater desalination technology and cultivation of saline-tolerant fodder crops such as fodder beat, bonicam and blubank .The use of leather processing tectology and production of the finest leather industries of shoes and bags .China has imported large amounts of ostriches from South Africa and used the best breeding and ostrich production systems in South Africa. The most important factors leading to the success of the ostrich industry in china are limited into three factors. First: Nutrition and cheap feed should be provided by planting enough alfalfa. Using solar energy to irrigate these lands. Sowing saline and drought tolerant genotypes, such as blubanks and bonecam, as well as machines for cutting and making pellet for green feed. Second: Hatching Third: Health.

Key words: Egg, handling, hatchability, incubation, management, ostrich.

INTRODUCTION

Ostrich (*Struthio camelus*) has become one of the valuable agricultural enterprises and has now become an important commercial species in many countries of the world **(Mahrose, 2007; Jelgat, 2009; Mahrose *et al*., 2016; Abbas *et al*., 2018)**. Recent interest in ostrich farming has led to an increasing demand for information about this bird and how to manage it in a commercial environment **(Cooper *et al*., 2008; El-Safty and Mahrose, 2009; Mahrose, 2012; Mahrose *et al*., 2015; Mahrose *et al*., 2019)**. Rising demand is attributed to the low content of energy, total lipids, cholesterol and saturated fat, and the high content of protein and iron relative to that of beef, veal, pork, lamb, poultry, rabbit and horse meat **(Alhomaid and Ali, 2013)**. Therefore, the specific goal of this work is to give a spotlight on the ostrich farming in China.

China has become Asian's number one ostrich raiser with about 20,000 ostriches bred farms **(Zhang *et al*., 2002 and Xinhua, 2004)**. The same authors added that China started in 1992 to import some ostrich species that was indigenous to Africa. China imported four

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ostrich breeds: Black Neck (African Black), Blue Neck, Red Neck and Australian Grey, as two hens to one rooster as a production unit in the breeding farms **(Zhang *et al*., 2002)**. Fossil remains of ostriches have been found in lower pliocene formations in Pao Te Hsien, NorthWest Shan'xi, on the Yellow River, China; and fossil eggs have been found in a region from North-NorthWest to South-Southwest of Kalgan on the border of Shan'xi and Inner Mongolia **(Abbas *et al*., 2018)**. The ancient Chinese had heard about its existence in the Middle East, and eggs and even living birds were occasionally sent to the imperial court from Persia and neighboring countries **(Buffetaut and Angst, 2017).** There are no more wild ostriches in China as fossil remains have been found, where ostriches have disappeared from a large part of their range for perhaps a million years **(Zhang, 2000)**.

The most important factors leading to the success of the ostrich industry are limited into three factors as previously: illustrated.

First: Nutrition and cheap feed should be provided by planting alfalfa in enough acreage. Solar energy was used to irrigate these lands. Sowing saline and drought tolerant genotypes, such as blubanks and bonecam, as well as using machines for cutting and pressing green feed were used.

Second: Hatching compared with chickens, the artificial incubation requirements of ostrich eggs are poorly understood, which is considered to be well below that achieved in the natural nests of ostriches **(Burger and Bertram, 1981; Faki *et al*., 2015)**. Ostrich egg incubation is still the unique most important factor affecting productivity which is still incompletely known. Artificial incubation is considered to be the only way to get good results in ostrich production because the natural incubation not suitable to commercial ostrich production on any significant scale **(Hallam, 1992)**. Hatchability percentages of ostrich eggs in Australia and England is reported to be less than 50%, while it ranged from 35% to 70% in South Africa **(Horbanczuk and Sales, 1998)**. The maximum values for hatchability of ostrich eggs are poor as around 60%, while hatchability of fertile eggs is high, as at best only around 70% of fertile eggs are producing live chicks **(Deeming and Ar, 1999; Van Schalkwyk *et al*., 2000)**. **Bunter *et al.* (2001)** concluded that the number of produced chicks was highly correlated with egg production. Low hatchability of ostriches is well known and many chicks that do hatch subsequently die **(Mahrose, 2007)**. The factors that affect hatchability including egg hygiene, egg storage conditions and period, incubation temperature, humidity, egg orientation, egg turning, ventilation and sanitation. Incubation temperature ranges from 35.9-36.5ºC) **(Wilson, 2003)**. Estimated relative humidity requirements are 15-20% during incubation and 40% during hatching. Optimal turning frequency has not been determined for ostrich fertile eggs. However, better results can be achieved by turning the eggs once per hour automatically. Levels of oxygen and carbon dioxide that need to be maintained in the incubator for ostrich eggs are 21% and 0.05-0.10% respectively. Egg weight loss during incubation is important if high hatchability is to be achieved where an egg weight loss of 12-17% during the 38 days of incubation is recommended for ostrich eggs. The major factors contributed to egg weight loss are shell porosity, relative humidity, egg size and incubation temperature **(Wilson, 2003)**.

Low hatchability could be caused by poor control of incubation parameters (temperature, humidity, air circulation, egg position and turning), improper egg handling (egg collection, egg washing methods, improper egg storage) and egg quality (egg size, nutrients in eggs, shell thickness and porosity) **(Cooper, 2001).** the nutritional status of female ostriches and microbial contamination of the egg .affect the hatchability and subsequent survival rate of chicks. However, oedemas and malposition are key factors causing embryo mortality, particularly when the head of the embryo is positioned at the end of the egg away from the air space, death in embryos was caused by severe oedema (45%) alone and in combination with malpositioning (55%) during the last 10-14 days of incubation **(Ley *et al.,* 1986)**.

Egg Quality

Ostrich egg weight ranges from 350 to over 2200 g.but ostrich egg weighs range of 1300 to 1700 g gives the best hatchability. Ideally, incubating eggs of similar weight in the same batch will yield good results as the incubation conditions are easier to maintain. Extremely large and small eggs have lower hatchability due insufficient weight loss during incubation. Egg weight loss during the incubation is 8.8-19.7%, and 15.6% in nature and weight loss of 13-15% during artificial incubation is preferable **(Mahrose, 2007)**. Eggshell thickness also affects hatchability and egg pore density of ostrich eggs is positively related to egg weight loss and hatchability. Eggshell thickness is not related to egg size, but medium sized eggs had significantly higher eggshell porosity (number of large pores per cm^2 of shell), higher egg weight loss and higher hatchability as compared to small or large eggs **(Gonzales *et al.,* 1999)**.

Time of Egg Collection

Eggs should be collected several times a day with the last collection at sundown that eggs should collected 10- 15 minutes after laying **(Cooper, 2001)**. Eggs left in the nest are frequently rolled, damaged or even eaten by adults and increases susceptibility to bacterial infection, particular when left overnight (**Stewart, 1996**). Eggs collected in the evening resulted in lower mortality of chicks than collected next morning **(Van Schalkwyk, 1998)**. Immersion sanitization of the egg shell does not improve hatchability of internally contaminated eggs. Large numbers of eggs should be placed in padded crates to minimize shaking during transport. Eggs should be handled with disposable gloves or a plastic bag or sterile towel to prevent possible contamination **(Cooper, 2001)**.

Egg Cleaning

Keeping eggs clean is an effective way to prevent contamination. Nests should be located away from feeding areas to reduce faecal contamination (**Copper, 2001)**. Sand should place in the nests and regularly replaced to keep the nests clean and dry. A common practice is to remove adherent dirt on the egg with a dry cloth or sand paper when collected **(Glatz, 2000)**. A dry egg should be lightly buffed with a soft-bristle brush only on specific areas to remove adherent dirt without destroying the cuticle. Eggs may be carefully rinsed, sprayed, or immersed in warm solutions, including sodium hypochlorite, chlorhexidine, quaternary ammonium compounds or phenolics. However, these methods may damage the cuticle and lower resistance to subsequent bacterial contamination. If the egg is wet or contaminated, the surface is dried with a blow drier and then buffed. The eggs can be air dried and placed in storage. In the domestic poultry industry, the egg surface is coated with a fine layer of commercial disinfectant solution containing either a quaternary ammonium or phenolic compound formulated to prevent contamination **(Stewart, 1996)**. Disinfectants are applied either by a hand spray, aerosol, or by fogging. And should not produce any residue on the shell surface which may interfere with air exchange through pores during incubation **(Glatz, 2000)**. Severely contaminated eggs can be washed by immersed in a 37.8°C phenolic or quaternary ammonium solution for 30-45 seconds, but the procedure may reduce hatchability by encouraging movement of micro-organisms from the surface into the interior of the egg. Eggs are rinsed in clean water and dried using a sterile towel **(Shane and Minteer, 1896)**. The eggs can be safely cleaned by a dry cloth first and then lightly mist-sprayed with 5 g/l of a Virkon solution **(Cooper, 2001)**. Hatchability percentage is higher and late embryonic death was lower for the eggs disinfected by UV as compared to eggs washed using a peroxigen powder compound and quaternary ammonium **(Van Shalkwyk *et al.,* 1997)**.

Storage

Ostrich eggs are normally stored for up to a week before being artificially incubated. But at the start and the end of the season, storage may be even longer in order to ensure that sufficient eggs are available **(Deeming and Ar, 1999)**. Hatchability mean percentage was higher in eggs stored less than or equal to10 days than eggs stored >15 : 24 days, but hatchability of eggs stored >10 is less than or equal to 15 days was not different from eggs stored is less than or equal to10 or >15 : 24 days as noted by **Hassan *et al.* (2005)**. They added that the most effective storage period was less than 15 days to maintain hatchability for ostrich eggs when incubated at 36.5 to 37.0°C with 25% RH. There is no standard method to store ostrich eggs in terms of temperature, humidity and turning. Embryos start to develop at 29.4°C but ostrich eggs held at or above this temperature degree showed an increase in early embryonic mortality after the second day of incubation, can be stored for 7 days under UV lighting but Eggs maintained between 12.8°C and 18.3°C may be safely stored for 7 days, but hatchability will be significantly reduced after 10 days. **Bertram (1979)** found that eggs can be safely stored up to 10days at 18ºC and 69% RH. **Nahm (2001)** found that eggs can be safely stored up to 19days at 15.5-15.6ºC without controlling the humidity. RH near 75% is recommended to prevent water loss from eggs during storage. **Hassan *et al.* (2004**) recommended storage RH should be around 35% to prevent the development of over hydrated chicks. Eggs should be turned daily or rotated 180º once daily (**Mahrose, 2007**).

Incubation Temperature

Eggs can be successfully incubated over the range 35.0 - 37.0°C. The optimum incubation temperature is 36.4°C. Increasing incubation temperature from 36.0 to 37.2° will reduce hatchability from 73 to 44%. **Horbanczuk (2002)** claimed that the length of the incubation is principally associated with temperature. **Hassan *et al.* (2004)** noted that when temperature increased from 36.5 to 37.5°C incubation period decreased from 41.51 to 39.34 days.

Incubation Humidity

Ideally, the actual humidity level used to incubate ostrich eggs should be based on the average of weight loss for all eggs produced from the flock. To get a weight loss of 13.4% to 39 days of incubation, RH should be less than 30-35% during incubation **(Abbas *et al.*, 2018)**. Insufficient egg weight loss or the lowest weight losses (<7%) and highest weight losses (>17%) will result in low hatchability with deficient chicks.

Air Circulation and Ventilation

Circulation is the movement of air within the incubator. As air flow rate in the incubator is about 45L/hr./egg. Ventilation is required to supply oxygen and reduce carbon dioxide level in the incubator. However, there is lack of information on ostrich incubation ventilation. Recommendations for commercial poultry incubation are above 20.5% of oxygen and below 0.5% of carbon dioxide. Hatchability was reduced by about 5% for each 1% decrease in oxygen and above 0.5% CO_2 in the incubation air can increase embryonic death **(Abbas *et al.*, 2018)**.

Position and Turning of Eggs

Deeming (2009) recommended that vertical setting eggs and rotated through 90º around the short axis will produce acceptable hatchability. The same author added that turning eggs during incubation improves hatchability by stimulating the growth of the embryo preventing the embryo attaching to the inner shell membrane and providing a uniform temperature. The eggs should be turned at least twice daily (8 to 10 times per day is better) until 39days when the eggs are transferred to the hatcher.

Rearing Systems

Intensive rearing

Stocking density needed by ostrich chicks depends on the type of housing but Semi-intensive rearing of birds is the most widely used method and even during intensive keeping of ostriches in controlled environment houses it is advisable to let them out to minimize occurrence of leg problems **(Du Preez, 1991)**. Chicks are kept indoors during the first 3-7days with a rearing temperature of 26-32ºC, thereafter they are moved out onto pastures during the 3-7 days. Under this system, chicks can be kept in the rearing house until 3-4 weeks of age where 30-50 chicks are kept in a 3 × 3m enclosure and 3 × 10m exercise area for 4 weeks. Then birds are moved to large areas (25 × 25 m) with heated shelters (22ºC). Outdoor enclosures can be made of timber or steel posts sheets with 75% shade cloth about 1.0-1.2 m high is sufficient to keep ostrich chicks up to 12 weeks of age **(Tuckwell, 1997)**.

Semi-intensive

In this system, 25- 50 days old ostrich chicks are raised on pasture (usually lucern) with 45cm high fences until about 6 weeks. A concentrate diet is provided and chicks are kept in a shelter with heating during the night. Movable shelters are common which enable birds to have access to fresh pasture. Birds of about 6 weeks of age will be moved to a large enclosure which can hold 150 birds and fed on chopped lucern and concentrates **(Verwoerd *et al.*, 1999)**.

Proper flooring

It is important for bedding to reduce ostrich chick mortality, therefore rough concrete or concrete covered with rubber mats, or galvanized welded mesh raised 2 -100 cm above the floor. The floor is concrete **(Mahrose, 2007)** with dry hay bedding covered by mesh to stop hay ingestion and to separate the chicks from urine

Heating for Chicks

Temperature

In a commercial farming environment, ostrich chicks are normally kept in the hatcher or brooder at a temperature about 32ºC for 1-2 days after hatching **(Deeming *et al.,* 1996)**. However, temperatures used for young ostrich chicks vary from 21-26.5ºC to 32-35ºC in the industry. It recommended that the youngest chicks should be raised under temperature starting around 30ºC with a drop of 0.5ºC each day until reach 26ºC (±1ºC) (**Verwored *et al.,* 1999**). However, the whole brooder room is heated by domestic oil heaters and temperature maintained above 30°C for 2-7 days. Heating sources can be infrared light, ceramic oil, gas lamp or electrical heaters thermostat control of temperatures is crucial to prevent overheating **(Verwoerd *et al.,* 1999)**.

Feeding Chicks

Absorption of the yolk sac provides nutrients for ostrich chicks for the first few days, that chicks can be kept without food and water for 6-8 days after hatching. The chopped fresh lucern fed with starter diets will stimulate intake of food, the place should be free of wire or sticks which can be ingested and penetrate the proventriculus, resulting in death. Rapid growth over 2-4 months of age results in leg deformation which eventually leads to the death of some ostrich chicks with mortality rates as high as of 41.20% therefore, high fiber diets and more exercise may be help to reduce the mortality **(Cooper *et al*., 2005; Elhashmi *et al*., 2011)**.

The development of ostrich industry is hampered by inadequate knowledge of nutritional requirements of this species, particularly those pertaining to the early–life stage (**Iji, 2005; Dube *et al*., 2009)**. Nutrition is an important part of poultry and ratite management. So, knowledge of nutrient needs during the various stages of growth, development and production of the ostrich are vital **(Cooper *et al*., 2005; Carstens *et al*., 2014)**. Nutrition of ostrich chicks must be correct, as they are most vulnerable up to the age of 3 months **(Cooper, 2004)**. In order to increase profitability of ostriches, determination of nutrient requirements of ostriches are essential **(Cilliers *et al*., 1998)**. The inclusion of protein in feeds needs to be optimized for optimum performance as well as to minimize wastage **(Engku Azahan and Noraziah, 2011)**. Ostriches require rations with high protein content, an essential ingredient for optimum growth and development **(Cooper, 2004)**. Feeding costs are the largest expense in an ostrich production system, and protein is one of the more expensive components of the diet **(Carstens *et al*., 2014)**. Diverse recommendations concerning the protein content in starter diets (14.6 – 22% CP) of ostriches has been reported. Most ratite growers feed diets that contain 17–24% crude protein during brooding and growing **(Cilliers, 1998)**.

Ostrich Health

Ostriches may be infected by viruses carried by wild birds and other animals which interact with them. Farmers should be aware of signs of illness, including staying alone, standing hunched up, laying down on, lethargy, not eating, loss of vigour, changes in faeces or urine, vomiting, coughing, panting, lameness, dull, brittle feathers and swelling on the body or legs **(Muvhali, 2018).** Maintaining good hygiene, proper housing and brooding and adequate stocking rate can improve ostrich welfare and production. Ostriches are susceptible to diseases found in avian species **(Abbas *et al*., 2018)**. Contact with wild birds or commercial poultry, environmental stresses including high stocking density and poor hygiene could cause infections. Most diseases are related to farm management including feed and water supply, climate, stress, hygiene and incubator/brooder management. Proper management of these areas can reduce the risk of disease infection. For example, viruses bacterial fungal and parasitic diseases

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تـــربيــــــــة النعــــــام فـــــــي الــصيـــــــــــن

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انتشرت تربية النعام في السنوات الأخيرة في العديد من دول العالم. يرجع سبب تقدم الصين فى إنتاج النعام وقفزها من المركز الخامس إلى المركز الثانى فى السنوات الأخيرة بسبب توافر العوامل الآتية: مساحة المراعى التى بلغت ٤٠% من مساحة الصين وكميات ضخمة من المخلفات الزراعية، إنتاج محاصيل علف مهجنه عالية الإنتاج مثل السورجم (٦٠ طن فى ثلاث حشات) والسوبر نيوبير جراس (١٨٠طن للفدان وبروتين ١٦% بروتين)، تقدم الصين فى إنتاج الحديد وبالتالى أنتجت أرخص الماكينات الزراعية مثل آلات الرى وتقطيع الأعلاف وكبسها، تقدم الصين فى الصناعات الالكترونيية التى مكنتها من إنتاج ماكينات التفريخ بأسعار رخيصة والنهوض بصناعة الدواجن، تقدم الصين فى استخدام الطاقة الشمسية وإنتاج طاقة رخيصة تستخدم فى رى الأراضى الزراعية وتشغيل آلات المزرعة، مما أدى إلى إنتاج أعلاف رخيصة الثمن أدت إلى انخفاض تكلفه تغذية طائر النعام بأقل ما يمكن، بالإضافة إلى استخدام تكنولوجيا تحلية مياه البحار وزراعة محاصيل الأعلاف التى تتحمل الملوحة مثل ينجر العلف وأعشاب البونيكام والبلوبنك، وكذلك استخدام تكنولوجيا تصنيع الجلود وإنتاج أجود الصناعات الجلدية من الأحذية والشنط والمعاطف، واستوردت الصين كميات كبيرة من النعام من جنوب أفريقيا واستخدمت أحدث أنظمة تربية وإنتاج النعام فى جنوب افريقيا، وأهم العوامل التى تؤدى إلى نجاح صناعة النعام تنحصر فى ثلاث عوامل، أولاً: التغذية ويجب توفير الغذاء الرخيص وذلك عن طريق زراعة المساحة الكافية بالبرسيم الحجازى، واستخدم الطاقة الشمسية فى رى هذه الأراضى، واستخدام الماكينات لتقطيع الأعلاف الخضراء وتجفيفها وجرشها وكبسها، ثانياً: التفريخ (جودة البيض – وقت جمع البيض – نظافة البيض – تخزين البيض – درجه الحرارة ودرجة الرطوبة والتهوية والتقليب لكل من الحضانة والمفقس)، ثالثاً: الصحة (التحصين ضد الأمراض الفيروسية والبكتيرية والفطرية والطفيليات الداخلية والخارجة).

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