ENHANCING DUCK WELL-BEING THROUGH EARLY-AGE STIMULATION, HUMAN-ANIMAL INTERACTION, AND PROBIOTIC SUPPLEMENTATION

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Chairman : Prof. Dato' Zulkifli bin Idrus, PhD
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Intensive modern poultry production exposes birds to a multitude of stressors, posing substantial challenges to their welfare. However, there is still a lack of research on the effects of positive human-animal interaction, early-life stress, and a probiotic-supplemented diet on stress resilience, fearfulness, and growth performance in ducks undergoing processes like catching, crating, and transportation. This thesis aims to fill this gap. Hence, the thesis's first objective was to investigate the effects of positive human contact on fear and physiological stress in Pekin ducks (*Anas platyrhynchos domesticus*) subjected to crating and transport. This study exposed the ducks to human contact across various age groups. At D 42, serum levels of corticosterone (CORT), heat shock protein 70 (HSP70), and tonic immobility (TI) tests were analysed following 3 hours of crating or 3 hours of transport stresses. The study reveals that ducks that received human contact from D1 to D42 and from D1 to D21 had significantly higher levels of HSP70 expression than the no-contact group, but human contact had no effect on growth performance.

Human contact and stressors significantly affected the TI duration. The second objective aimed to determine the effects of early-life stress on growth performance, fear, and physiological stress responses, as well as gut microflora composition in both Pekin and Muscovy *(Cairina moschata)* ducks subjected to transportation stress at market age. The ducks were stressed at D3 to D14 by keeping them in a climate chamber set at 24°C±1 and hearing 100 dB of noise (construction and road traffic noises) for three hours every day, and at D42, the ducks underwent three hours of transportation stress. Blood analyses for CORT and HSP70 were done at D14 and D42. The RT-PCR for the gut microbiota count and TI tests were conducted at D42. The results showed that subjecting Pekin ducks to early-life stress can alleviate the stress associated with transportation at market age by significantly changing the CORT and HSP70 levels in Pekin ducks but not in Muscovy ducks. The TI test demonstrated a significant breed difference, with Muscovy ducks exhibiting a longer TI duration and more attempts compared to Pekin ducks. The Pekin ducks showed significantly higher weight gains and feed intake compared to Muscovy ducks. Early-life stress is also beneficial in maintaining the gut population of *Lactobacillus spp*. following transportation.

For the third and fourth objectives, the experiments were conducted on Pekin ducks that were fed with probiotic-supplemented feed containing CLOSTAT® (*Bacillus subtilis*) at a concentration of 1 g/kg on D1 to D21. Blood tests for heterophil-to-lymphocyte ratio (HLR), serum biochemistry such as creatine kinase (CK), total protein (TP), triglycerides (TG), glucose (GLU), total cholesterol (CHOL), and lactate (LACT), stress hormonal (CORT and HSP70), TI, and exploratory behaviour tests were determined at D21 after 4 hours of crating stress.

The findings revealed that the dietary intervention did not exert a significant impact on growth performance. Despite this, the probiotic-added diet significantly reduced the levels of CORT, HSP70, HLR, TG, and CK in ducks compared to those fed the control diet. The exploratory and fear-related behaviour tests also showed that *B. subtilis* supplementation significantly decreased TI duration, lowered TI attempts, and increased their exploratory activity in a new environment. In summary, the experiments indicate that positive human contact, early life stress, and dietary probiotic supplementation collectively have a significant impact on stress resilience in ducks, but they did not affect growth performance.

Keywords: behaviour, duck, fear, human-animal interaction, probiotic, stress.

SDG: GOAL 1: End poverty, GOAL 2: End hunger, GOAL 12: Responsible consumption and production

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MENINGKATKAN KESEJAHTERAAN ITIK MELALUI RANGSANGAN AWAL USIA, INTERAKSI MANUSIA-HAIWAN DAN SUPLEMEN PROBIOTIK

Oleh

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Sistem pengeluaran unggas yang intensif mendedahkan unggas kepada pelbagai stress yang boleh menjejaskan kebajikan mereka. Namun begitu, masih ada kekurangan penyelidikan mengenai kesan interaksi manusia-haiwan yang positif, stres awal hayat, dan diet tambahan probiotik terhadap daya tahan stres, ketakutan, dan prestasi pertumbuhan itik dalam menhadapi proses penangkapan, kekangan dan pengangkutan. Tesis ini bertujuan untuk menerokai perkara ini. Oleh itu, objektif pertama tesis adalah untuk menyiasat kesan sentuhan manusia positif terhadap ketakutan dan stres fisiologi dalam itik Pekin *(Anas platyrhynchos domesticus*) terhadap kekangan dan pengangkutan. Kajian ini mendedahkan itik kepada sentuhan manusia di pelbagai peringkat umur. Pada D 42, tahap serum kortikosteron (CORT), protein kejutan haba 70 (HSP70), dan ujian imobiliti tonik (TI) dianalisa selepas 3 jam kekangan atau 3 jam pengangkutan.

Kajian itu mendapati bahawa itik yang menerima sentuhan manusia dari D1 hingga D42 dan dari D1 hingga D21 mempunyai tahap ekspresi HSP70 yang jauh lebih tinggi daripada kumpulan tanpa sentuhan manusia, tetapi sentuhan manusia tidak mempunyai kesan ke atas prestasi tumbesaran itik. Sentuhan manusia dan stres ini didapati mempengaruhi tempoh TI yang ketara. Objektif kedua bertujuan untuk menentukan kesan stres awal hayat terhadap prestasi tumbesaran, ketakutan, dan tindak balas tekanan fisiologi, serta komposisi mikroflora usus pada itik Pekin dan Muscovy (*Cairina moschata*) setelah mengalami stres pengangkutan pada usia pasaran. Dari D3 hingga D14 anak itik diletakan di dalam bilik pada suhu 24°C±1 dan didedahkan kepada 100 dB bunyi (bunyi kawasan pembinaan dan lalu lintas jalan) selama tiga jam setiap hari, dan pada D42, itik diangkut dengan lori selama tiga jam. Analisis darah untuk CORT dan HSP70 dilakukan pada D14 dan D42. Ujian RT-PCR untuk kiraan mikrobiota usus dan ujian TI telah dijalankan di D42. Keputusan menunjukkan bahawa stress awal hayat boleh mengurangkan tekanan yang berkaitan dengan pengangkutan pada usia pasaran dengan mengubah paras CORT dan HSP70 dengan ketara dalam itik Pekin tetapi tidak dalam itik Muscovy. Ujian TI menunjukkan perbezaan baka yang ketara, dengan itik Muscovy mempamerkan tempoh TI yang lebih lama dan lebih banyak percubaan berbanding itik Pekin. Itik Pekin menunjukkan pertambahan berat badan dan pengambilan makanan yang jauh lebih tinggi berbanding itik Muscovy. Tekanan awal hayat juga bermanfaat dalam mengekalkan populasi usus *Lactobacillus spp*. berikutan stres pengangkutan. Untuk objektif ketiga dan keempat, eksperimen dijalankan ke atas itik Pekin yang diberi makanan tambahan probiotik yang mengandungi CLOSTAT® (*Bacillus subtilis*) pada kepekatan 1 g/kg pada D1 hingga D21.

Ujian darah untuk nisbah heterofil-kepada-limfosit (HLR), biokimia serum seperti creatine kinase (CK), protein total (TP), trigliserida (TG), glukosa (GLU), kolesterol total (CHOL), dan laktat (LACT) , hormon tekanan (CORT dan HSP70), TI, dan ujian tingkah laku penerokaan ditentukan pada D21 selepas 4 jam stres kekangan. Penemuan menunjukan penambahan probiotik di dalam makanan tidak memberi kesan terhadap prestasi tumbesaran itik. Walaupun begitu, penambahan probiotik di dalam makanan itik telah mengurangkan tahap CORT, HSP70, HLR, TG, dan CK dalam itik dengan ketara berbanding mereka yang diberi diet kawalan selepas stress kekangan. Ujian penerokaan dan tingkah laku berkaitan ketakutan juga menunjukkan bahawa suplemen *B. subtilis* mengurangkan tempoh TI dengan ketara, merendahkan percubaan TI dan meningkatkan aktiviti penerokaan mereka dalam persekitaran baharu. Ringkasnya, eksperimen menunjukkan bahawa hubungan manusia yang positif, tekanan hidup awal, dan suplemen probiotik diet secara kolektif mempunyai kesan yang signifikan terhadap daya tahan tekanan dalam itik, tetapi ia tidak menjejaskan prestasi pertumbuhan.

Kata Kunci: itik, interaksi manusia-haiwan, ketakutan, tingkahlaku, stres

SDG: MATLAMAT 1: Tiada Kemiskinan, MATLAMAT 2: Sifar Kebuluran, MATLAMAT 12: Penggunaan dan Pengeluaran Bertanggungjawab

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF DIAGRAMS

LIST OF ABBREVIATIONS

CHOL	cholesterol
CK	creatine kinase
CORT	serum corticosterone level
DVS	Department of Veterinary Services, Malaysia
D	day/days
doa	day/days of age
GLU	glucose
HAR	human animal relationship
HLR	heterophil lymphocyte ratio
HSP70	heat shock protein 70
HPA	hypothalamic-pituitary-adrenal
LAC	lactate
m	Meter
min	minute/minutes
MGBA	microbiota-gut-brain-axis
mL	millilitre
NAT	novel arena test
OFT	open-field test
PCT	pen and cone test
RMT	presence of man test
rpm	revolutions per minute
s	second/seconds
TI	tonic immobility
TG	triglycerides
TP	total protein

UPM	Universiti Putra Malaysia
°C	degree Celsius

CHAPTER 1

INTRODUCTION

Advancements in genetics, nutrition, housing, and management strategies have propelled the modern poultry industry forward, fostering remarkable gains in productivity. However, this enhanced efficiency also brings birds closer to their physiological limits, heightening the significance of nutrition, environment, and management practices (Korver, 2023). In Malaysia, the duck production sector has undergone a significant evolution, transitioning from traditional backyard management to semi-intensive and finally to intensive systems. Initially, ducks were reared with basic shelter and access to open areas for movement and swimming (Azahan and Mokhtar, 1984). Over time, this approach has shifted towards more intensive methods, with ducks now housed in enclosed facilities. As per the Department of Veterinary Services Malaysia's 2021 data, the country's duck population stands at an estimated 9,678,749. Notably, in 2020, Singapore imported over 50% of Malaysia's duck population, reflecting a substantial export value of RM 124.14 million (DVS Statistic, 2020/2021).

Some of the key factors that can have a negative impact on poultry welfare if not handled carefully include human contact or handling (Acharya et al., 2022), housing systems (Abdel-Hamid et al., 2020), higher stocking density (Buijs et al., 2009; Cengiz et al., 2015), thermal stress (Zulkifli et al., 2009; Bueno et al., 2017; Chen et al., 2021b), crates (Weeks et al., 2019), and transportation (Jacobs et al., 2017; Scanes et al., 2020). Therefore, it's crucial to implement strategies aimed at enhancing poultry resilience and mitigating environmental stressors. It's widely recognised that both acute and chronic stress can have adverse effects on welfare (Dobson et al., 2007). Researchers have extensively investigated the advantages of early-life stressors, such as thermal stress, feed restriction, and noise, in promoting stress resilience in chickens later in life (Zulkifli et al., 2002b; Zhang et al., 2009; El-Moniary et al., 2010; Flores et al., 2019). However, there is a dearth of similar research on ducks..

Given the limited research on the effects of positive human interaction, early-life stress, and probiotic supplementation in ducks undergoing processes like catching, crating, and transportation, this thesis endeavours to address this gap. Its objective is to offer valuable insights into improving the welfare and performance of ducks within intensive poultry production systems. Through an examination of the impacts of positive human contact, early-life stress, and probiotic supplementation (specifically *B. subtilis*) on duck behaviour, the research aims to provide practical strategies for reducing stress and enhancing resilience in ducks. Ultimately, the goal is to improve ducks' overall well-being and productivity in such systems.

The quality of interactions between humans and animals significantly influences the productivity and welfare of farm animals (Acharya et al., 2022). Such interactions can evoke various responses in animals, ranging from neutral to positive or negative (Zulkifli, 2013). Studies have shown that frequent positive interactions with humans can induce favourable changes in chicken physiology, behaviour, health, and productivity (Taylor et al., 2022). Conversely, negative human contact can instill significant fear in animals, potentially impairing their growth and reproductive capabilities. Researchers have observed that regular visual and physical contact with commercial broiler chicks reduces underlying fearfulness in chickens (Zulkifli, 2013;

Rault et al., 2020). Panic responses in quail, characterised by hyperexcitability and violent escape reactions, are common reactions to fear (Mills & Faure, 1991). Extensive documentation exists on efforts to modify the physiological and behavioural characteristics of livestock species, including cattle, sheep, pigs, horses, and poultry, through consistent human interaction (Hemsworth & Gonyou, 1997; Hemsworth & Barnett, 2000). Inappropriate handling techniques that induce aversive experiences in farm animals can lead to avoidance behaviour, a manifestation of fear recognised as a stress response (Rushen et al., 1999).

When it comes to duck production, one important question that emerges is the duration during which physical human interaction and handling activities are crucial. Jones and Waddington (1992) found that there is no distinct period of heightened sensitivity for regular chick handling. Zulkifli et al. (2002a) found that regular visual interaction with humans during the initial 21 days of life in broiler chickens decreased anxiety and stress reactions to handling and crate confinement while simultaneously enhancing antibody responses. Gross (1983) and Zulkifli et al. (2002a) observed that stimulation during the early stages of life, a critical time when several biological systems are undergoing development, can have long-lasting consequences and impact gene expression. However, there is presently a lack of knowledge about the impact of physical human touch or handling on young ducks.

Literature suggests that poultry breeds and strains exhibit varying responses to environmental stressors (Debut et al., 2005; Huff et al., 2007; Campo et al., 2008; Soleimani et al., 2011). Studies by Faure et al. (2003), Guémené et al. (2006), and Arnaud et al. (2008) delved into the genetic underpinnings of stress and fear reactions in ducks and their hybrids. They observed that Pekin ducks displayed higher locomotor activity and were more fearful compared to Muscovy ducks, which exhibited a greater avoidance of humans. Interestingly, their hybrids (mule ducks) exhibited heightened panic responses and a specific fear of humans compared to the parental genotypes. Furthermore, studies have highlighted sex-specific differences in responses to environmental stressors. Elfwing et al. (2015) investigated the impact of early stress on chickens (Gallus gallus domesticus), focusing on sex-specific effects. The researchers discovered that males who experienced stress early in life had elevated levels of anxiety in an open field test, shorter periods of tonic immobility, and a tendency towards delayed sexual maturation. This was supported by lower levels of testosterone compared to the control group. Interestingly, females showed no such effects. Therefore, considering the breed and sex-specific responses to stress, male Pekin ducklings were mainly selected as the subjects for experimentation in this study.

Probiotic supplementation in poultry feed has shown inconsistent outcomes in terms of growth performance. The competition between beneficial bacteria for attachment sites and nutrients within the intestinal tract is the ultimate objective of displacing potentially deleterious bacteria using probiotics (Harimurti and Hadisaputro, 2015). Oladokun and Adewole (2023) conducted a study on the impact of probiotic-supplemented diets in chickens, using *Bacillus subtilis* and *Bacillus licheniformis,* and found no difference in average body weight gain or feed conversion ratio (FCR) between the treatment groups at D 35. In contrast with Guo et al.'s (2016) findings that dietary supplementation with *B. subtilis* enhances growth performance in Pekin ducks, Studies on the administration of probiotics derived from *Bacillus amyloquefaciens* have shown reduced aggression and distress vocalizations among turkeys (Abdel-

Azeem et al., 2013). Parois et al. (2017) conducted a study on the effects of dietary supplementation with a probiotic (*Pediococcus acidilactici*) on female Japanese quail (*Coturnix japonica*), which revealed a decrease in emotional reactivity and an improvement in memory among the quails. Given the extensive research and viable findings on the effect of *B. subtilis* supplementation in animal feed on growth performance but a lack of studies on behaviour, this probiotic was selected for the experiment.

Considering the unexplored areas and the dearth of information regarding the effects of human contact, early stress, and probiotic supplementation on stress resilience, underlying fearfulness, and behaviour in duck production, further investigation is warranted. Therefore, the objectives and hypotheses of the study were formulated as follows:

1.1 The Objectives

Therefore, the objectives of this study were:

1.1.1. to investigate the effects of positive human contact on fear and physiological stress in Pekin ducks (*Anas platyrhynchos domesticus*) subjected to crating and transport.

1.1.2. to determine the effects of early-life stress on growth performance, fear, and stress responses, as well as gut microflora composition in both Pekin and Muscovy ducks at market age subjected to transportation stress.

1.1.3. To determine the effect of *Bacillus subtilis* supplementation on growth performance, heterophil and lymphocyte ratio, serum biochemistry, and hormonal responses in stressed 21-day-old Pekin ducks.

1.1.4. To investigate the effects of *Bacillus subtilis* supplementation on exploratory and fear-related behaviours in stressed 21-day-old Pekin ducks.

1.2 The Hypotheses

In this study, the hypotheses were:

1.2.1 Positive human contact can enhance growth performance and mitigate stress and fear reactions in Pekin ducks undergoing crating and transportation.

1.2.2 Physiological stress and fear responses, as well as gut microbiota composition, in road-transported Pekin and Muscovy ducks at market age, may be influenced by early-life stress.

1.2.3 Supplementing diets with *Bacillus subtilis* enhances growth performance and may alleviate the physiological stress response to catching and crating in stressed 21 day old Pekin ducks.

1.2.4 Supplementation of *Bacillus subtilis* in the diet can alter the exploratory and fear-related behaviour in stressed 21 day old Pekin ducks.

REFERENCES

Abd El-Hack, M.E., El-Saadony, M.T., Shafi, M.E., Qattan, S.Y., Batiha, G.E., Khafaga, A.F., Abdel-Moneim, A.M.E. and Alagawany, M., 2020. Probiotics in poultry feed: A comprehensive review. Journal of Animal Physiology and Animal Nutrition, 104(6), pp.1835-1850.

Abdel-Azeem, N. (2013). Do probiotics affect the behaviour of turkey poults? Journal of Veterinary Medicine and Animal Health. 5. 144-148. 10.5897/JVMAH2012.0196.

Abdel-Hamid, S. E., Saleem, A. S. Y., Youssef, M. I., Mohammed, H. H., & Abdelaty, A. I. (2020). Influence of housing systems on duck behaviour and welfare. Journal of Advanced Veterinary and Animal Research, 7(3), 407.

Abdel-Moneim, A. M. E., Selim, D. A., Basuony, H. A., Sabic, E. M., Saleh, A. A., & Ebeid, T. A. (2020). Effect of dietary supplementation of Bacillus subtilis spores on growth performance, oxidative status, and digestive enzyme activities in Japanese quail birds. Journal of Tropical Animal Health and Production, 52, 671-680.

Abidin, Z. Z., Idris, F. H., Ramiah, S. K., Awad, E. A., Zakaria, Z., & Idrus, Z. (2023). The effects of feed withdrawal, transport and lairage on intestinal microflora in broiler chickens, Egypt. Journal of Animal Health and Production, 11(1), 68-72.

Abu-Alya, I. S., Abdelrahman, H., & Zahran, I. (2022). Effect of Antistress Formula on Alleviation of Uninterrupted 900 Km Transport Stress Impacts in Japanese Quail (Coturnix japonica). Journal of Current Veterinary Research, 4(1), 118-127.

Abudabos, A. M., Alyemni, A. H., Dafalla, Y. M., & Khan, R. U. (2017). Effect of organic acid blend and Bacillus subtilis alone or in combination on growth traits, blood biochemical and antioxidant status in broilers exposed to Salmonella typhimurium challenge during the starter phase. Journal of Applied Animal Research, 45(1), 538-542.

Acharya, R. Y., Hemsworth, P. H., Coleman, G. J., & Kinder, J. E. (2022). The animal-human interface in farm animal production: Animal fear, stress, reproduction and welfare. Animals, 12(4), 487.

Adriani, L., Kumalasari, C., Joni, M., & Latipudin, D. (2022). Effect of powder probiotic on the leukocyte, heterophil and lymphocyte level on laying hens. Scientific Papers. Series D. Animal Science, 65(1).

Ahmad, R.; Yu, Y.H.; Hsiao, F.S.H.; Su, C.H.; Liu, H.C.; Tobin, I.; Zhang, G.; Cheng, Y.H. (2022). Influence of heat stress on poultry growth performance, intestinal inflammation, and immune function and potential mitigation by probiotics. Animals. 12, 2297.

Al-Aqil A. and Zulkifli I. (2009). Changes in heat shock protein 70 expression and blood characteristics in transported broiler chickens as affected by housing and early age feed restriction. Poultry Science, Volume 88, Issue 7, 1 July 2009, Pages 1358–1364.

Al-Aqil, A., Zulkifli, I., Hair Bejo, M., Sazili, A., Rajion, M., & Somchit, M. (2013). Changes in heat shock protein 70, blood parameters, and fear-related behaviour in broiler chickens as affected by pleasant and unpleasant human contact. Poultry Science.,92(1), 33-40.

Al-Khalaifah, H. S. (2018). Benefits of probiotics and/or prebiotics for antibiotic-reduced poultry. Poultry Science, 97(11), 3807-3815.

Al-Murrani, W. K., Al-Rawi, A. J., Al-Hadithi, M. F., & Al-Tikriti, B. (2006). Association between heterophil/lymphocyte ratio, a marker of 'resistance'to stress, and some production and fitness traits in chickens. British Poultry Science, 47(4), 443-448.

Alagawany, M.; El-Hack, A.; Mohamed, E.; Farag, M.R.; Sachan, S.; Karthik, K.; Dhama, K. (2018). The use of probiotics as eco-friendly alternatives for antibiotics in poultry nutrition. Environmental Science and Pollution Research., 25, 10611–10618

Al Fataftah, A. R. & Abdelqader, A. (2014). Effects of dietary Bacillus subtilis on heat-stressed broilers performance, intestinal morphology and microflora composition. Animal Feed Science and Technology. 198. 10.1016/j.anifeedsci.2014.10.012.

Algers, B.; Ekesbo, I. and Sromberg, S. (1978): The impact of continous noise on animal health. Acta Veterinaria Scandinavica. 19 (suppl. 67), 1-26

Aliakbarpour, H. R., Chamani, M., Rahimi, G., Sadeghi, A. A., & Qujeq, D. (2012). The Bacillus subtilis and lactic acid bacteria probiotics influences intestinal mucin gene expression, histomorphology and growth performance in broilers. Asian-Australasian Journal of Animal Sciences, 25(9), 1285.

Angelier, F., Parenteau, C., Ruault, S., Angelier, N. (2016). Endocrine consequences of an acute stress under different thermal conditions: A study of corticosterone, prolactin, and thyroid hormones in the pigeon (Columbia livia). Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology. 196. 10.1016/j.cbpa.2016.02.010.

Arnaud, Isabelle & Grasteau, Sandrine & Larzul, Catherine & Guy, Gerard & Faure, Jean-Marc & Guémené, Daniel. (2008). Behavioural and physiological fear responses in ducks: Genetic cross effects. Animal: An International Journal of Animal Bioscience. 2. 1518-25.

Arnaud, Isabelle & Gardin, Emilie & Sauvage, Emilie & Bernadet, Marie-Dominique & Couty, Michel & Guy, Gerard & Guémené, Daniel. (2010). Behavioural and adrenal responses to various stressors in mule ducks from different commercial genetic selection schemes and their respective parental genotypes. Poultry Science. 89. 1097-109. 10.3382/ps.2009-00553.

Ashraf, S., Zaneb, H., Yousaf, M. S., Ahmad, I., Sohail, M. U., Muti, S., Usman, M., Ijaz, S. & Rehman, H. (2013). Effect of dietary supplementation of prebiotics and probiotics on intestinal microarchitecture in broilers reared under cyclic heat stress. Journal of Animal Physiology and Animal Nutrition. 97 Suppl 1. 68-73. 10.1111/jpn.12041.

Ashayerizadeh, A.; Dabiri, N.; Mirzadeh, K.H.; Ghorbani, M.R. (2011). Effect of dietary supplementation of probiotic and prebiotic on growth indices and serum biochemical parameters of broiler chickens. Journal of Cell and Animal Biology. 5, 152–156.

Astheimer, L. B., Buttemer, W. A., & Wingfield, J. C. (1992). Interactions of corticosterone with feeding, activity and metabolism in passerine birds. Ornis Scandinavica, 355-365.

Azahan, E., & Mokhtar, N. (1984). Performance of Pekin ducks in smallholdings under different rearing systems. MARDI Research Bulletin (Malaysia), 12(2).

Bahman, N., J.B. Liang, and M. F. Jahromi. (2012). Correlation coefficients between different methods of expression of bacterial quantification using real time PCR. International Journal of Molecular Sciences. 13:2119–2132.

Bai, S. P., Wu, A. M., Ding, X. M., Lei, Y., Bai, J., Zhang, K. Y., & Chio, J. S. (2013). Effects of probiotic-supplemented diets on growth performance and intestinal immune characteristics of broiler chickens. Poultry Science, 92(3), 663-670.

Balakrishnan K. N., Ramiah S. K, Zulkifli I., 2023. Heat Shock Protein Response to Stress in Poultry: A Review. Animals.; 13(2):317.

Barbe, M. F., Tytell, M., Gower, D. J., & Welch, W. J. (1988). Hyperthermia protects against light damage in the rat retina. Science, 241(4874), 1817-1820.

Barbosa, T. S. Mori, C. K., Polônio, L. B., Ponsano, E. H. G., Ciarlini, P. C. (2011). Perfil bioquímico sérico de galinhas poedeiras na região de Araçatuba, SP. Semina: Ciências Agrárias, Londrina, v. 32, n. 4, p. 1583-1588.

Basile, F., Capaccia, C., Zampini, D., Biagetti, T., Diverio, S., & Guelfi, G. (2020). Omics insights into animal resilience and stress factors. Animals, 11(1), 47.

Bell, A. M. (2007). Future directions in behavioural syndromes research. Proceedings of the Royal Society of London B: Biological Sciences, 274(1611), 755e761. http:// dx.doi.org/10.1098/rspb.2006.0199.

Bello U. A., Idrus, Z., Yong Meng, G., Awad, E. A., & Soleimani Farjam, A. (2018). Gut microbiota and transportation stress response affected by tryptophan supplementation in broiler chickens. Italian Journal of Animal Science, 17(1), 107-113.

Benus, R. F., Bohus, B., Koolhaas, J. M., & Van Oortmerssen, G. A. (1991). Behavioural differences between artificially selected aggressive and non-aggressive mice: response to apomorphine. Behavioural Brain Research, 43(2), 203-208.

Berman, A. (2005). Estimates of heat stress relief needs for feeder cattle. Journal of Animal Science, 83(6), 1377-1384.

Bienenstock, J., Kunze, W., & Forsythe, P. (2015). Microbiota and the gut–brain axis. Nutrition Reviews, 73(suppl_1), 28-31.

Bierschenk, F. (1991) Tips und Tricks zur Aufzucht von Wassergeflügel. Deutsche Geflügelwirtschaft und Schweineproduktion 11: 303-305.

Birkl, P., Bharwani, A., Kjaer, J. B., Kunze, W., McBride, P., Forsythe, P., & Harlander-Matauschek, A. (2018). Differences in cecal microbiome of selected high and low feather-pecking laying hens. Poultry Science, 97(9), 3009-3014.

Boissy, A. (1995). Fear and fearfulness in animals. The Quarterly Review of Biology. 70, 165–191.

Boissy, A., & Erhard, H. W. (2014). How studying interactions between animal emotions, cognition, and personality can contribute to improve farm animal welfare. In Genetics and the behaviour of domestic animals (pp. 95-129). Academic Press.

Boissy, A., Manteuffel, G., Jensen, M.B., Moe, R.O., Spruijt, B., Keeling, L.J., Winckler, C., Forkman, B., Dimitrov, I., Langbein, J. and Bakken, M. (2007). Assessment of positive emotions in animals to improve their welfare. Physiology & Behaviour, 92(3), pp.375-397.

Boivin, X., Tournadre, H., & Le Neindre, P. (2000). Hand-feeding and gentling influence early-weaned lambs' attachment responses to their stockperson. Journal of Animal Science, 78(4), 879-884.

Book, C.M., Bradley, F.A., 1990. Behavioural effects of simulated F-4D aircraft overflights on Nicholas turkey poults. Poultry Science. 69 (Suppl. 1), 22.

Borda-Molina, D., Roth, C., Hérnandez-Arriaga, A., Rissi, D., Vollmar, S., Rodehutscord, M., Bennewitz, J. and Camarinha-Silva, A. (2020). Effects on the ileal microbiota of phosphorus and calcium utilization, bird performance, and gender in Japanese quail. Animals, 10(5), p.885.

Breuer, K., Hemsworth, P. H., & Coleman, G. J. (2003). The effect of positive or negative handling on the behavioural and physiological responses of nonlactating heifers. Applied Animal Behaviour Science, 84(1), 3-22.

Breuner, C. W., Greenberg, A. L., & Wingfield, J. C. (1998). Noninvasive corticosterone treatment rapidly increases activity in Gambel's white-crowned sparrows (Zonotrichia leucophrys gambelii). General and comparative endocrinology, 111(3), 386-394.

Broom, D.M., 2000. Welfare assessment and welfare problem areas during handling and transport. In: Grandin, T. (ed.), Livestock Handling and Transport, pp: 43–62. CABI Publishing, Wallingford, UK

Brown, K. I., & Nestor, K. E. (1974). 2. Implications of selection for high and low adrenal response to stress. Poultry Science, 53(4), 1297-1306.

Borre, Y.E.; Moloney, R.D.; Clarke, G.; Dinan, T.G.; Cryan, J.F. (2014). The impact of microbiota on brain and behaviour: Mechanisms & therapeutic potential. In Microbial Endocrinology: The Microbiota-Gut-Brain Axis in Health and Disease; Springer: New York, NY, USA. pp. 373–403.

Bueno, J.P.R., de Mattos Nascimento, M.R.B., da Silva Martins, J.M., Marchini, C.F.P., Gotardo, L.R.M., de Sousa, G.M.R., Mundim, A.V., Guimarães, E.C. and Rinaldi, F.P. (2017). Effect of age and cyclical heat stress on the serum biochemical profile of broiler chickens. Semina: Ciências Agrárias, 38(3), pp.1383-1392.

Buijs, S., Keeling, L., Rettenbacher, S., Van Poucke, E., & Tuyttens, F. A. M. (2009). Stocking density effects on broiler welfare: Identifying sensitive ranges for different indicators. Poultry science, 88(8), 1536-1543.

Burnard C, Ralph C, Hynd P, Edwards JH, Tilbrook AJ (2017) Hair cortisol and its potential value as a physiological measure of stress response in human and non-human animals. Animal Production Science 57, 401–414

Burokas, A., Moloney, R. D., Dinan, T. G., & Cryan, J. F. (2015). Microbiota regulation of the mammalian gut–brain axis. Advances in applied microbiology, 91, 1-62.

Calandreau, L., Favreau-Peigné, A., Bertin, A., Constantin, P., Arnould, C., Laurence, A., Lumineau, S., Houdelier, C., Richard-Yris, M.A., Boissy, A. and Leterrier, C. (2011). Higher inherent fearfulness potentiates the effects of chronic stress in the Japanese quail. Behavioural Brain Research, 225(2), pp.505-510.

Campo, J. L., Dávila, S. G., Gil, M. G., Torres, O., & Moreno, J. S. (2015). Fear and stress measurements in pure and hybrid red-legged partridges. Applied Animal Behaviour Science, 166, 123-130.

Campo, J. L., Gil, M. G., Dávila, S. G., & Muñoz, I. (2007). Effect of lighting stress on fluctuating asymmetry, heterophil-to-lymphocyte ratio, and tonic immobility duration in eleven breeds of chickens. Poultry Science, 86(1), 37-45.

Campo, J. L., Prieto, M. T., & Davila, S. G. (2008). Effects of housing system and cold stress on heterophil-to-lymphocyte ratio, fluctuating asymmetry, and tonic immobility duration of chickens. Poultry Science, 87(4), 621-626.

Cashman, P. J., Nicol, C. J., & Jones, R. B. (1989). Effects of transportation on the tonic immobility fear reactions of broilers. British Poultry Science, 30(2), 211-221.

Carenzi, C., & Verga, M. (2009). Animal welfare: review of the scientific concept and definition. Italian Journal of Animal Science, 8(sup1), 21-30.

Carere, C., & Maestripieri, D. (2013). Animal personalities: behaviour, physiology, and evolution. University of Chicago Press.

Carter, A. J., Feeney, W. E., Marshall, H. H., Cowlishaw, G., & Heinsohn, R. (2013). Animal personality: what are behavioural ecologists measuring? Biological Reviews, 88(2), 465-475.

Cartoni Mancinelli, A., Mugnai, C., Castellini, C., Mattioli, S., Moscati, L., Piottoli, L., Guarino Amato, M., Doretti, M., Dal Bosco, A., Cordovani, E. and Abbate, Y., (2018). Effect of transport length and genotype on tonic immobility, blood parameters and carcass contamination of free-range reared chickens. Italian Journal of Animal Science, 17(3), pp.557-564.

Casasole, G., Raap, T., Costantini, D., AbdElgawad, H., Asard, H., Pinxten, R., & Eens, M. (2017). Neither artificial light at night, anthropogenic noise nor distance from roads are associated with oxidative status of nestlings in an urban population of songbirds. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 210, 14-21.

Cengiz, Ö., Köksal, B.H., Tatlı, O., Sevim, Ö., Ahsan, U., Üner, A.G., Ulutaş, P.A., Beyaz, D., Büyükyörük, S., Yakan, A. and Önol, A.G. (2015). Effect of dietary probiotic and high stocking density on the performance, carcass yield, gut microflora, and stress indicators of broilers. Poultry Science, 94(10), pp.2395-2403.

Chen, W. L., J. B. Liang, M. F. Jahromi, N. Abdullah, Y. W. Ho, and V. Tufarelli. (2015). Enzyme treatment enhances release of prebiotic oligosaccharides from palm kernel expeller. BioResources 10:196–209.

Chen, Y.C.; Tao, N.L.; Hu, S.Y.; Tsai, H.Y.; Liao, S.C.; Tsai, W.L.; Hu, C.Y. (2021a). Effect of tempeh on gut microbiota and anti-stress activity in Zebrafish. International Journal of Molecular Sciences. 22, 12660.

Chen, S., Yong, Y., & Ju, X. (2021b). Effect of heat stress on growth and production performance of livestock and poultry: Mechanism to prevention. Journal of Thermal Biology, 99, 103019.

Chirico, W. J., Waters, M. G., & Blobel, G. (1988). 70K heat shock related proteins stimulate protein translocation into microsomes. Nature, 332(6167), 805-810.

Chloupek, P., Vecerek, V., Voslarova, E., Bedanova, I., Suchy, P., Pistekova, V., & Kozak, A. (2008). Effects of different crating periods on selected biochemical indices in broiler chickens. Berliner und Munchener Tierarztliche Wochenschrift, 121(3/4), 132.

Chloupek, P.; Voslářová, E.; Chloupek, J.; Bedáňová, I.; Pištěková, V.; Večerek, V. (2009). Stress in broiler chickens due to acute noise exposure. Acta Veterinaria Brno. 78, 93–98.

Chuka, E. (2014). Comparative study of the effects of probiotic and commercial enzyme on growth rate, haematology and serum biochemistry of broiler chicken.

Clark, A. B., & Ehlinger, T. J. (1987). Pattern and adaptation in individual behavioural differences. In Perspectives in ethology: volume 7 alternatives (pp. 1-47). Boston, MA: Springer US.

Claxton, A. M. (2011). The potential of the human–animal relationship as an environmental enrichment for the welfare of zoo-housed animals. Applied Animal Behaviour Science, 133(1-2), 1-10.

Clarke, A., & Schneider, M. L. (1993). Prenatal stress has long-term effects on behavioural responses to stress in juvenile rhesus monkeys. Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology, 26(5), 293-304.

Colditz, I. G., & Hine, B. C. (2016). Resilience in farm animals: biology, management, breeding and implications for animal welfare. Animal Production Science, 56(12), 1961-1983.

Coleman, G.J., Hemsworth, P.H., Hay, M. and Cox, M. (2000). Modifying stockperson attitudes and behaviour towards pigs at a large commercial farm. Applied Animal Behaviour Science, 66(1-2), pp.11-20.

Cotter, P. F. (2015). An examination of the utility of heterophil-lymphocyte ratios in assessing stress of caged hens. Poultry Science, 94(3), 512-517.

Conway, P. L. (1994). Function and regulation of the gastrointestinal microbiota of the pig. Publication-European Association for Animal Production, 80, 231-231.

Collins, J. W., & Siegel, P. B. (1987). Human handling, flock size and responses to an E. coli challenge in young chickens. Applied Animal Behaviour Science, 19(1-2), 183-188.

Cowansage, K.K.; LeDoux, J.E.; Monfils, M.H. (2010). Brain-derived neurotrophic factor: A dynamic gatekeeper of neural plasticity. Current Molecular Pharmacology, 3, 12–29.

Craig, E.A. (1985). The heat shock response. Crit. Rev. Biochemical Journal.18: 239-280.

Craig, E. A., & Gross, C. A. (1991). Is hsp70 the cellular thermometer? Trends in Biochemical Sciences, 16, 135-140.

Crews, D., Gillette, R., Scarpino, S. V., Manikkam, M., Savenkova, M. I., & Skinner, M. K. (2012). Epigenetic transgenerational inheritance of altered stress responses. Proceedings of the National Academy of Sciences, 109(23), 9143-9148.

Crino, O. L. (2013). Developmental stress in birds: Phenotypic and fitness consequences. University of Montana.

Crino, O. L., Johnson, E. E., Blickley, J. L., Patricelli, G. L., & Breuner, C. W. (2013). Effects of experimentally elevated traffic noise on nestling white-crowned sparrow stress physiology, immune function and life history. Journal of Experimental Biology, 216(11), 2055-2062.

Cryan, J. F., & Dinan, T. G. (2012). Mind-altering microorganisms: the impact of the gut microbiota on brain and behaviour. Nature Reviews Neuroscience, 13(10), 701-712.

Cryan, J.F. & O'Mahony, S.M. (2011) The microbiome-gut-brain axis: From bowel to behaviour. Journal of Neurogastroenterology and Motility. 23, 187–192.

Cryan, J.F.; O'Riordan, K.J.; Cowan, C.S.; Sandhu, K.V.; Bastiaanssen, T.F.; Boehme, M.; Codagnone, M.G.; Cussotto, S.; Fulling, C.; Golubeva, A.V. (2019). The microbiota-gut-brain axis. The Journal of Physiology Reviews. 99, 1877–2013.

Cully, M. (2019). Antibiotics alter the gut microbiome and host health. Natural Resources Journal, 15, S19.

D'Aquila PS, Brain P, Willner P (1994). Effects of chronic mild stress on performance in behavioural tests relevant to anxiety and depression. Physiology & Behaviour. 56: 861–867.

Dalab, A.S.; Ali, A.M.; Althnaian, T.A.; Alkhodair, K.M.; Al-Ramadan, S.Y. (2022). Molecular and ultrastructural investigations of the effect of thermal manipulation during embryogenesis on pectoral and thigh muscles growth factors in broilers. Journal of Applied Poultry Research. 31, 100188

Davidson, G.L.; Cooke, A.C.; Johnson, C.N.; Quinn, J.L. (2018). The gut microbiome as a driver of individual variation in cognition and functional behaviour. Philosophical Transactions of the Royal Society B: Biological Sciences. 373, 20170286

Dávila, S. G., Campo, J. L., Gil, M. G., Prieto, M. T., & Torres, O. (2011). Effects of auditory and physical enrichment on 3 measurements of fear and stress (tonic immobility duration, heterophil to lymphocyte ratio, and fluctuating asymmetry) in several breeds of layer chicks. Poultry Science, 90(11), 2459-2466.

Debut, M., Berri, C., Arnould, C., Guemené, D., Santé-Lhoutellier, V., Sellier, N., Baéza, E., Jehl, N., Jégo, Y., Beaumont, C. and Le Bihan-Duval, E., 2005. Behavioural and physiological responses of three chicken breeds to pre-slaughter shackling and acute heat stress. British Poultry Science, 46(5), pp.527-535.

Dechesne, C. J., Kim, H. N., Nowak Jr, T. S., & Wenthold, R. J. (1992). Expression of heat shock protein, HSP72, in the guinea pig and rat cochlea after hyperthermia: immunochemical and in situ hybridization analysis. Hearing Research, 59(2), 195-204.

De Haas, E. N., & van der Eijk, J. A. (2018). Where in the serotonergic system does it go wrong? Unravelling the route by which the serotonergic system affects feather pecking in chickens. Neuroscience & Biobehavioural Reviews, 95, 170-188.

Des Roches, A. D. B., Veissier, I., Boivin, X., Gilot-Fromont, E., & Mounier, L. (2016). A prospective exploration of farm, farmer, and animal characteristics in human-animal relationships: An epidemiological survey. Journal of Dairy Science, 99(7), 5573-5585.

Dingemanse, N. J., Wright, J., Kazem, A. J., Thomas, D. K., Hickling, R., & Dawnay, N. (2007). Behavioural syndromes differ predictably between 12 populations of three-spined stickleback. Journal of Animal Ecology, 1128-1138.

Dinan, T. G., & Cryan, J. F. (2012). Regulation of the stress response by the gut microbiota: implications for psychoneuroendocrinology. Psychoneuroendocrinology, 37(9), 1369-1378.

Dobson, H., Smith, R. F., Royal, M. D., Knight, C. H., & Sheldon, I. M. (2007). The high-producing dairy cow and its reproductive performance. Reproduction in Domestic Animals, 42, 17-23.

Dowarah, R., Verma, A. K., & Agarwal, N. (2017). The use of Lactobacillus as an alternative of antibiotic growth promoters in pigs: A review. Animal Nutrition, 3(1), 1-6.

Drent, P, J., van Oers, K., Van Noordwijk, A. J. (2003). Realized heritability of personalities in the great tit (Parus major). Proceedings of the Royal Society B: Biological Sciences. 270:45–51.

Drummond, H. (1985). The role of vision in the predatory behaviour of natricine snakes. Animal Behaviour, 33(1), 206-215.

Duncan, I. J. (2002). Poultry welfare: science or subjectivity? British Poultry Science, 43(5), 643-652.

Duncan, I. J. H., & Mench, J. A. (1993). Behaviour as an indicator of welfare in various systems. Basic Biology and Welfare. Alternative Housing Systems, 7(1), 69-76.

Duncan, I. J. H., Slee, G. S., Kettlewell, P., Berry, P., & Carlisle, A. J. (1986). Comparison of the stressfulness of harvesting broiler chickens by machine and by hand. British Poultry Science, 27(1), 109-114.

Eckert, N.H., Lee, J.T., Hyatt, D., Stevens, S.M., Anderson, S., Anderson, P.N., Beltran, R., Schatzmayr, G., Mohnl, M. and Caldwell, D.J. (2010). Influence of probiotic administration by feed or water on growth parameters of broilers reared on medicated and nonmedicated diets. Journal of Applied Poultry Research, 19(1), pp.59-67.

Edwards L. E., Coleman G. J., Hemsworth P. H. (2013). Close human presence reduces avoidance behaviour in commercial caged laying hens to an approaching human. Animal Production Science. 53, 1276-1282.

Elfwing, M., Nätt, D., Goerlich-Jansson, V. C., Persson, M., Hjelm, J., & Jensen, P. (2015). Early stress causes sex-specific, life-long changes in behaviour, levels of gonadal hormones, and gene expression in chickens. PLoS One, 10(5), e0125808.

El-Moniary, M. M. A., Hemid, A. A., El-Wardany, I., Gehad, A. E., & Gouda, A. (2010). The effect of early age heat conditioning and some feeding programs for heat-stressed broiler chicks on: 1-Productive performance. World Journal of Agricultural Sciences, 6, 689-695.

Etches, R. J., John, T. M., & Gibbins, A. V. (2008). Behavioural, physiological, neuroendocrine and molecular responses to heat stress. In Poultry production in hot climates (pp. 48-79). Wallingford UK: CABI.

Fairchild, B. D. (2009). Environmental factors to control when brooding chicks. University of Georgia. College of Agricultural and Environmental Sciences. University of Georgia. Dept. of Poultry Science. Bulletin; 1287

FAO (2002). Guidelines for the Evaluation of Probiotics in Food. In Report of a Joint FAO/WHO Working Group on Drafting Guidelines for the Evaluation of Probiotics in food; FAO: London, ON, Canada.

Farouk, M. M., Al-Mazeedi, H. M., Sabow, A. B., Bekhit, A. E. D., Adeyemi, K. D., Sazili, A. Q., & Ghani, A. (2014). Halal and kosher slaughter methods and meat quality: A review. Meat Science, 98(3), 505-519.

Faure, J. M., Jones, R. B., & Bessei, W. (1983). Fear and social motivation as factors in open-field behaviour of the domestic chick. A theoretical consideration. Biology of Behaviour, 8, 103-116.

Faure, J. M., Bessei, W., & Jones, R. B. (2003). 13 Direct Selection for Improvement of Animal Well-being.

Favati, A., Zidar, J., Thorpe, H., Jensen, P., & Løvlie, H. (2016). The ontogeny of personality traits in the red junglefowl, Gallus gallus. Behavioural Ecology, 27(2), 484-493.

Fazhi, X., Lvmu, L., Jiaping, X., Kun, Q., Zhide, Z., & Zhangyi, L. (2011). Effects of fermented rapeseed meal on growth performance and serum parameters in ducks. Asian-Australasian Journal of Animal Sciences, 24(5), 678-684.

Flores, R., Penna, M., Wingfield, J. C., Cuevas, E., Vásquez, R. A., & Quirici, V. (2019). Effects of traffic noise exposure on corticosterone, glutathione and tonic immobility in chicks of a precocial bird. Conservation Physiology, 7(1), coz061.

Forkman, B., Boissy, A., Meunier-Salaün, M. C., Canali, E., & Jones, R. B. (2007). A critical review of fear tests used on cattle, pigs, sheep, poultry and horses. Physiology & Behaviour, 92(3), 340-374.

Forte, C., Acuti, G., Manuali, E., Proietti, P.C., Pavone, S., Trabalza-Marinucci, M., Moscati, L., Onofri, A., Lorenzetti, C. and Franciosini, M.P. (2016). Effects of two different probiotics on microflora, morphology, and morphometry of gut in organic laying hens. Poultry Science, 95(11), 2528-2535.

Fraser, A. F., & Broom, D. M. (1997). Farm animal behaviour and welfare (No. Ed. 3). CAB international.

Gallup Jr, G. G. (1977). The common denominator of most situations designed to induce tonic immobility is some form of physical restraint, such as holding an animal down on a flat surface for a brief period. Following termination of restraint, rather than getting to its feet and trying to escape the animal remains physically immobile (see Figure 1) and assumes an almost. The Psychological Record, 1, 41-61.

Gallup, G. G. (1979). Tonic immobility as a measure of fear in domestic fowl. Animal Behaviour.

Gallup Jr, G. G., & Suarez, S. D. (1980). An ethological analysis of open-field behaviour in chickens. Animal Behaviour, 28(2), 368-378.

Gee, D. G., & Casey, B. J. (2015). The impact of developmental timing for stress and recovery. Neurobiology of stress, 1, 184-194.

Ghareeb, K., Awad, W. A., Nitsch, S., Abdel-Raheem, S., & Böhm, J. (2008). Effects of transportation on stress and fear responses of growing broilers supplemented with prebiotic or probiotic. International Journal of Poultry Science, 7(4), 678-685.

Ghasemian, M., & Jahanian, R. (2016). Dietary mannan-oligosaccharides supplementation could affect performance, immunocompetence, serum lipid metabolites, intestinal bacterial populations, and ileal nutrient digestibility in aged laying hens. Animal Feed Science and Technology, 213, 81-89.

Goerlich, V. C., Nätt, D., Elfwing, M., Macdonald, B., & Jensen, P. (2012). Transgenerational effects of early experience on behavioural, hormonal and gene expression responses to acute stress in the precocial chicken. Hormones and Behaviour, 61(5), 711-718.

Gray, J. A. (1987). The psychology of fear and stress (Vol. 5). Cambrige University Press Archive.

Greenberg, R. (1995). Novelty responses: the bridge between psychology, behavioural ecology, and community ecology. Trends in Ecology and Evolution, 10:165-166.

Greggor, A. L., Thornton, A., & Clayton, N. S. (2015). Neophobia is not only avoidance: improving neophobia tests by combining cognition and ecology. Current Opinion in Behavioural Sciences, 6, 82-89.

Gresse, R., Chaucheyras-Durand, F., Fleury, M. A., Van de Wiele, T., Forano, E., & Blanquet-Diot, S. (2017). Gut microbiota dysbiosis in postweaning piglets: understanding the keys to health. Trends in microbiology, 25(10), 851-873.

Gross, W. B. (1983). Chicken-environment interactions. Pages 329–337 in: Ethics and Animals. H. B. Miller and W. H. Williams, ed. Humana Press, Clifton, NJ

Gross, W. B., & Siegel, P. B. (1979). Adaptation of chickens to their handler, and experimental results. Avian Diseases, 708-714.

Gross, W. B., & Siegel, P. B. (1980). Effects of early environmental stresses on chicken body weight, antibody response to RBC antigens, feed efficiency, and response to fasting. Avian Diseases, 569-579.

Gross, W. B., & Siegel, H. S. (1983). Evaluation of the heterophil/lymphocyte ratio as a measure of stress in chickens. Avian Diseases, 972-979.

Gross, W. B., & Siegel, P. B. (1985). Selective breeding of chickens for corticosterone response to social stress. Poultry Science, 64(12), 2230-2233.

Guémené, D., Guy, G., Noirault, J., Garreau-Mills, M., Gouraud, P., & Faure, J. M. (2001). Force-feeding procedure and physiological indicators of stress in male mule ducks. British Poultry Science, 42(5), 650-657.

Guémené, D., & Guy, G. (2004). The past, present and future of force-feeding and “foie gras” production. World's Poultry Science Journal, 60(2), 210-222.

Guémené, D., Guy, G., Noirault, J., Destombes, N., & Faure, J. M. (2006). Rearing conditions during the force-feeding period in male mule ducks and their impact upon stress and welfare. Animal research, 55(5), 443-458.

Guillette, L. M., Hahn, A. H., Hoeschele, M., Przyslupski, A. M., & Sturdy, C. B. (2015). Individual differences in learning speed, performance accuracy and exploratory behaviour in black-capped chickadees. Animal Cognition, 18, 165-178.

Goudie, R. I., & Jones, I. L. (2004). Dose-response relationships of harlequin duck behaviour to noise from low-level military jet over-flights in central Labrador. Environmental Conservation, 31(4), 289-298.

Guo, M., Hao, G., Wang, B., Li, N., Li, R., Wei, L., & Chai, T. (2016). Dietary administration of *Bacillus subtilis* enhances growth performance, immune response and disease resistance in Cherry Valley ducks. Frontiers in Microbiology, 7, 1975.

Gustafson, L. A., Cheng, H. W., Garner, J. P., Pajor, E. A., & Mench, J. A. (2007). Effects of bill-trimming Muscovy ducks on behaviour, body weight gain, and bill morphopathology. Applied Animal Behaviour Science, 103(1-2), 59-74.

Guzman, D. A., Satterlee, D. G., Kembro, J. M., Schmidt, J. B., & Marin, R. H. (2009). Effect of the density of conspecifics on runway social reinstatement behaviour of male Japanese quail genetically selected for contrasting adrenocortical responsiveness to stress. Poultry Science, 88(12), 2482-2490.

Habibu, B., Dzenda, T., Ayo, J. O., Yaqub, L. S., & Kawu, M. U. (2018). Haematological changes and plasma fluid dynamics in livestock during thermal stress, and response to mitigative measures. Livestock Science, 214, 189-201.

Hahn,G.M. and Li,G.C. (1990) In Morimoto,R.I., Tissieres,A. and Georgopoulos,C. (eds), Stress Proteins in Biology and Medicine. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 79-100.

Hanafi, S.A., Zulkifli, I., Ramiah S.K., Chung, E.L.T., Kamil R., Awad, E.A. (2023). Prenatal auditory stimulation induces physiological stress responses in developing embryos and newly hatched chicks, Poultry Science, Volume 102, Issue 2,

Harms, C. A., Fleming, W. J., & Stoskopf, M. K. (1997). A technique for dorsal subcutaneous implantation of heart rate biotelemetry transmitters in black ducks: application in an aircraft noise response study. The Condor, 99(1), 231-237.

Hartl, F.U. and Hayer-Hartl, M. (2002). Molecular chaperones in the cytosol: from nascent chain to folded protein. Science. 295, 1852–1858.

Hartl, F.-U., Hlodan, R. and Langer, T. (1994). Molecular chaperones in protein folding: the art of avoiding sticky situations. Trends in Biochemical Sciences, 19, 20–25.

Harvey, S., Merry, B. J., & Phillips, J. G. (1980). Influence of stress on the secretion of corticosterone in the duck (Anas platyrhynchos). Journal of Endocrinology, 87(1), 161-171.

Hausberger, M., Roche, H., Henry, S., & Visser, E. K. (2008). A review of the human–horse relationship. Applied animal behaviour science, 109(1), 1-24.

Harimurti, S., & Hadisaputro, W. (2015). Probiotics in poultry. Beneficial microorganisms in agriculture, aquaculture and other areas, 1-19.

Hazard, D., Couty, M., Richard, S., & Guémené, D. (2008). Intensity and duration of corticosterone response to stressful situations in Japanese quail divergently selected for tonic immobility. General and Comparative Endocrinology, 155(2), 288-297.

He, J., He, Y., Pan, D., Cao, J., Sun, Y., & Zeng, X. (2019). Associations of gut microbiota with heat stress-induced changes of growth, fat deposition, intestinal morphology, and antioxidant capacity in ducks. Frontiers in Microbiology, 10, 903.

Hemsworth, P. H., Barnett, J. L., & Coleman, G. J. (2009). The integration of human-animal relations into animal welfare monitoring schemes. Animal Welfare, 18(4), 335-345.

Hemsworth, P. H., & Gonyou, H. W. (1997). Human contact.

Hemsworth, P. H., & Barnett, J. L. (2000). Human-animal interactions and animal stress. In The biology of animal stress: basic principles and implications for animal welfare. (pp. 309-335). Wallingford UK: CABI Publishing.

Hemsworth P. H., Coleman G. J. (1998). Human-Livestock Interactions: The Stockperson and the Productivity and Welfare of Intensively Farmed Animals. Wallingford, UK: CAB International.

Hemsworth, P. H., & Coleman, G. J. (2011). Second Edition. Human-animal interactions and animal productivity and welfare. Wallingford, UK CAB International.

Hemsworth, P. H., Coleman, G. J., Barnett, J. L., & Borg, S. (2000). Relationships between human-animal interactions and productivity of commercial dairy cows. Journal of Animal Science, 78(11), 2821-2831.

Hemsworth, P. H., Coleman, G. J., Barnett, J. L., Borg, S., & Dowling, S. (2002). The effects of cognitive behavioural intervention on the attitude and behaviour of stockpersons and the behaviour and productivity of commercial dairy cows. Journal of Animal Science, 80(1), 68-78.

Hemsworth, P. H., Coleman, G. J., Barnett, J. L., & Jones, R. B. (1994). Behavioural responses to humans and the productivity of commercial broiler chickens. Applied Animal Behaviour Science, 41(1-2), 101-114.

Hemsworth, P. H., Mellor, D. J., Cronin, G. M., & Tilbrook, A. J. (2015). Scientific assessment of animal welfare. New Zealand veterinary journal, 63(1), 24-30.

Hemsworth, P. H., Rice, M., Karlen, M. G., Calleja, L., Barnett, J. L., Nash, J., & Coleman, G. J. (2011). Human–animal interactions at abattoirs: Relationships between handling and animal stress in sheep and cattle. Applied Animal Behaviour Science, 135(1-2), 24-33.

Hemsworth, P. H., Barnett, J. L., & Hansen, C. (1986). The influence of handling by humans on the behaviour, reproduction and corticosteroids of male and female pigs. Applied Animal Behaviour Science, 15(4), 303-314.

Henderson, J. V., Nicol, C. J., Lines, J. A., White, R. P., & Wathes, C. M. (2001). Behaviour of domestic ducks exposed to mobile predator stimuli. 1. Flock responses. British Poultry Science, 42(4), 433-438.

Hermans, D., Pasmans, F., Heyndrickx, M., Van Immerseel, F., Martel, A., Van Deun, K., & Haesebrouck, F. (2012). A tolerogenic mucosal immune response leads to persistent Campylobacter jejuni colonization in the chicken gut. Critical reviews in microbiology, 38(1), 17-29.

Hewson, C. J. (2003). What is animal welfare? Common definitions and their practical consequences. The Canadian Veterinary Journal, 44(6), 496.

Hickey, M. C., Drennan, M., & Earley, B. (2003). The effect of abrupt weaning of suckler calves on the plasma concentrations of cortisol, catecholamines, leukocytes, acute-phase proteins and in vitro interferon-gamma production. Journal of Animal Science, 81(11), 2847-2855.

Huang, M. K., Choi, Y. J., Houde, R., Lee, J. W., Lee, B., & Zhao, X. (2004). Effects of Lactobacilli and an acidophilic fungus on the production performance and immune responses in broiler chickens. Poultry Science, 83(5), 788-795.

Huff, G. R., Huff, W. E., Rath, N. C., De Los Santos, F. S., Farnell, M. B., & Donoghue, A. M. (2007). Influence of hen age on the response of turkey poults to cold stress, Escherichia coli challenge, and treatment with a yeast extract antibiotic alternative. Poultry science, 86(4), 636-642.

Hughes, B. O., & Black, A. J. (1976). The influence of handling on egg production, egg shell quality and avoidance behaviour of hens. British Poultry Science, 17(2), 135-144.

Injaian, A. S., Gonzalez-Gomez, P. L., Taff, C. C., Bird, A. K., Ziur, A. D., Patricelli, G. L., Wingfield, J. C. (2019). Traffic noise exposure alters nestling physiology and telomere attrition through direct, but not maternal, effects in a free-living bird. General and Comparative Endocrinology, 276, 14-21.

Isaacson, R., & Kim, H. B. (2012). The intestinal microbiome of the pig. Animal health research reviews, 13(1), 100-109.

Jacobs, L., Delezie, E., Duchateau, L., Goethals, K., & Tuyttens, F. A. (2017). Impact of the separate pre-slaughter stages on broiler chicken welfare. Poultry Science, 96(2), 266-273.

Jadhav, K., Sharma, K. S., Katoch, S., Sharma, V. K., & Mane, B. G. (2015). Probiotics in broiler poultry feeds: A review. Journal of Animal Physiology and Animal Nutrition, 1, 4-16.

Janczak, A. M., Torjesen, P., Palme, R., & Bakken, M. (2007). Effects of stress in hens on the behaviour of their offspring. Applied Animal Behaviour Science, 107(1-2), 66-77.

Jayaprakash, G., Sathiyabarathi, M., Robert, M. A., & Tamilmani, T. (2016). Transportation stress in broiler chicken. International Journal of Science, Environment and Technology, 5(2), 806-809.

Jayaraman, S., Das, P. P., Saini, P. C., Roy, B., & Chatterjee, P. N. (2017). Use of Bacillus Subtilis PB6 as a potential antibiotic growth promoter replacement in improving performance of broiler birds. Poultry Science, 96(8), 2614-2622.

Jenni L., Jenni-Eiermann, S., Spina, F., and Schwabl, H. (2000). Regulation of protein breakdown and adrenocortical response to stress in birds during migratory flight. American Physiological Society Journal, 278:R1182–R1189.

Jensen, M. B., & Budde, M. (2006). The effects of milk feeding method and group size on feeding behaviour and cross-sucking in group-housed dairy calves. Journal of Dairy Science, 89(12), 4778-4783.

Jha, R., Das, R., Oak, S., & Mishra, P. (2020). Probiotics (direct-fed microbials) in poultry nutrition and their effects on nutrient utilization, growth and laying performance, and gut health: A systematic review. Animals, 10(10), 1863.

Jiang, J. F., Song, X. M., Wu, J. L., & Jiang, Y. Q. (2014). Effects of alfalfa meal on the intestinal microbial diversity and immunity of growing ducks. Journal of Animal Physiology and Animal Nutrition, 98(6), 1039-1046.

Jones, R. B. (1987). Assessment of fear in adult laying hens: correlational analysis of methods and measures. British Poultry Science, 28(2), 319-326.

Jones, R. B. (1992). The nature of handling immediately prior to test affects tonic immobility fear reactions in laying hens and broilers. Applied Animal Behaviour Science, 34(3), 247-254.

Jones R. B., (1996). Fear and adaptability in poultry: insights, implications and imperatives. World's Poultry Science Journal. 52:133-7.

Jones, R.B. (1987a). Social and environmental aspects of fear in the domestic fowl. In: R. Zayan and I.J.H. Duncan (Editors), Cognitive Aspects of Social Behaviour in the Domestic Fowl. Elsevier, Amsterdam, pp. 82- 149.

Jones, R.B. (1987b). The assessment of fear in the domestic fowl. In: R. Zayan and I.J.H. Duncan (Editors), Cognitive Aspects of Social Behaviour in the Domestic Fowl. Elsevier, Amsterdam, pp. 40-99.

Jones, R. B. (1986a). The tonic immobility reaction of the domestic fowl: a review. World's Poultry Science Journal, 42(1), 82-96.

Jones, R. B. (1986b). Conspecific vocalisations, tonic immobility and fearfulness in the domestic fowl. Behavioural Processes, 13(3), 217-225.

Jones, R. B., Satterlee, D. G., & Ryder, F. H. (1992). Fear and distress in Japanese quail chicks of two lines genetically selected for low or high adrenocortical response to immobilization stress. Hormones and Behaviour, 26(3), 385-393.

Jones, R. B., Mills, A. D., Faure, J. M., & Williams, J. B. (1994). Restraint, fear, and distress in Japanese quail genetically selected for long or short tonic immobility reactions. Physiology & Behaviour, 56(3), 529-534.

Jones, R. B., Mills, A. D., & Faure, J. M. (1991). Genetic and experiential manipulation of fear-related behaviour in Japanese quail chicks (Coturnix coturnix japonica). Journal of Comparative Psychology, 105(1), 15.

Jones, R.B. and Faure, J.M. (1982). Open field behaviour of male and female domestic chicks as a function of housing conditions, test situations and novelty. Biolology Behaviour., 7: 17-25.

Jones, R.B. and Mills, A.D., 1983. Estimation of fear in two lines of the domestic chick: correlations between various methods. Behavioural Processes., 8: 243-253.

Jones, R. B., Satterilee, D. G., & Ryder, F. H. (1994a). Fear of humans in Japanese quail selected for low or high adrenocortical response. Physiology & Behaviour, 56(2), 379-383.

Jones, R. B., Mills, A. D., Faure, J. M., & Williams, J. B. (1994b). Restraint, fear, and distress in Japanese quail genetically selected for long or short tonic immobility reactions. Physiology & Behaviour, 56(3), 529-534.

Jones, R. B. (1997). Fear and Distress. Pages 75–87 in Animal Welfare. M. C. Appleby and B. O. Hughes, ed. CAB, Wallingford, UK

Jones, R. B. (1995). Habituation to human beings via visual contact in docile and flighty strains of domestic chicks. Int. J. Comp. Psychol. 8:88–98. Jones, R. B. 1996. Fear and adaptability in poultry: Insights, implications and imperatives. World's Poultry Science Journal, 52:131–174.

Jones, B., & Boissy, A. (2011). Fear and other negative emotions. In Animal welfare (pp. 78-97). Wallingford UK: CABI.

Jones, R.B. and Hughes, B.O. (1981). Effects of regular handling on growth in male and female chicks of broiler and layer strains. British Poultry Science, 22:461-465.

Jones, R.B. and Waddington, D. (1992). Modification of fear in domestic chicks, Callus gallus domesticus, via regular handling and early environmental enrichment. Animal Behaviour, 43: 1021-1033.

Jones, R. B. (1993). Reduction of the domestic chick's fear of human beings by regular handling and related treatments. Animal Behaviour, 46(5), 991-998.

Jones, R. B., & Merry, B. J. (1988). Individual or paired exposure of domestic chicks to an open field: some behavioural and adrenocortical consequences. Behavioural Processes, 16(1-2), 75-86.

Kaiser, S., & Sachser, N. (2005). The effects of prenatal social stress on behaviour: mechanisms and function. Neuroscience & Biobehavioural Reviews, 29(2), 283-294.

Kalavathy, R.; Abdullah, N.; Jalaludin, S.; Ho, Y.W. (2003). Effects of Lactobacillus cultures on growth performance, abdominal fat deposition, serum lipids and weight of organs of broiler chickens. British Poultry Science, 44, 139–144.

Kandir, E.H.; Yardimci, M. (2015). Effects of kefir on growth performance and carcass characteristics in Pekin ducks (Anas platyrhynchos domestica). Journal of Animal Research, 5, 207–212.

Kamada, N., Seo, S. U., Chen, G. Y., & Núñez, G. (2013). Role of the gut microbiota in immunity and inflammatory disease. Nature Reviews Immunology, 13(5), 321-335.

Kannan, G., Heath, J. L., Wabeck, C. J., Souza, M. C., Howe, J. C., & Mench, J. A. (1997). Effects of crating and transport on stress and meat quality characteristics in broilers. Poultry Science, 76(3), 523-529.

Kannan, G.; Mench, J.A. (1996). Influence of different handling methods and crating periods on plasma corticosterone concentrations in broilers British Poultry Science, 37, 21–31.

Kannan, G., Terrill, T. H., Kouakou, B., Gelaye, S., & Amoah, E. A. (2002). Simulated preslaughter holding and isolation effects on stress responses and live weight shrinkage in meat goats. Journal of Animal Science, 80(7), 1771-1780.

Keeling, L., & Jensen, P. (2009). Abnormal behaviour, stress and welfare. In The ethology of domestic animals: an introductory text, modular texts (pp. 85-101). Wallingford UK: CABI.

Kers, J. G., Velkers, F. C., Fischer, E. A., Hermes, G. D., Stegeman, J. A., & Smidt, H. (2018). Host and environmental factors affecting the intestinal microbiota in chickens. Frontiers in Microbiology, 9, 235.

Khan, R. U., & Naz, S. (2013). The applications of probiotics in poultry production. World's Poultry Science Journal, 69(3), 621-632.

Khattab, A. A., El Basuini, M. F., El-Ratel, I. T., & Fouda, S. F. (2021). Dietary probiotics as a strategy for improving growth performance, intestinal efficacy, immunity, and antioxidant capacity of white Pekin ducks fed with different levels of CP. Poultry Science, 100(3), 100898.

King, S. L., & Hegadoren, K. M. (2002). Stress hormones: how do they measure up? Biological Research For Nursing, 4(2), 92-103.

Kittelsen, K. E., Granquist, E. G., Aunsmo, A. L., Moe, R. O., & Tolo, E. (2018). An evaluation of two different broiler catching methods. Animals, 8(8), 141.

Kleist, N. J., Guralnick, R. P., Cruz, A., Lowry, C. A., & Francis, C. D. (2018). Chronic anthropogenic noise disrupts glucocorticoid signaling and has multiple effects on fitness in an avian community. Proceedings of the National Academy of Sciences, 115(4), E648-E657.

Knowles, T. G., Warriss, P. D., & Vogel, K. (2014). Stress physiology of animals during transport. In Livestock handling and transport (pp. 399-420). Wallingford UK: CABI.

Knowles, T. G., & Broom, D. M. (1990). The handling and transport of broilers and spent hens. Applied Animal Behaviour Science, 28(1-2), 75-91.

Koba, Y., & Tanida, H. (1999). How do miniature pigs discriminate between people? The effect of exchanging cues between a non-handler and their familiar handler on discrimination. Applied Animal Behaviour Science, 61(3), 239-252.

Koch, K. A., Wingfield, J. C., & Buntin, J. D. (2004). Prolactin-induced parental hyperphagia in ring doves: are glucocorticoids involved? Hormones and Behaviour, 46(4), 498-505.

Kogut, M. H. (2019). The effect of microbiome modulation on the intestinal health of poultry. Animal Feed Science and Technology, 250, 32-40.

Koolhaas, J.M., Korte, S.M., De Boer, S.F., Van Der Vegt, B.J., Van Reenen, C.G., Hopster, H., De Jong, I.C., Ruis, M.A.W. and Blokhuis, H.J. (1999). Coping styles in animals: current status in behaviour and stress-physiology. Neuroscience & Biobehavioural Reviews, 23(7), pp.925-935.

Koolhaas, J.M., Bartolomucci, A., Buwalda, B., de Boer, S.F., Flügge, G., Korte, S.M., Meerlo, P., Murison, R., Olivier, B., Palanza, P. and Richter-Levin, G. (2011). Stress revisited: a critical evaluation of the stress concept. Neuroscience & Biobehavioural Reviews, 35(5), pp.1291-1301.

Korte, S. M., Olivier, B., & Koolhaas, J. M. (2007). A new animal welfare concept based on allostasis. Physiology & Behaviour, 92(3), 422-428.

Korver, D. R. (2023). Current challenges in poultry nutrition, health, and welfare. animal, 17, 100755.

Kraimi, N., Calandreau, L., Biesse, M., Rabot, S., Guitton, E., Velge, P., & Leterrier, C. (2018). Absence of gut microbiota reduces emotional reactivity in Japanese quails (Coturnix japonica). Frontiers in Physiology, 9, 603.

Kraimi, N., Dawkins, M., Gebhardt-Henrich, S.G., Velge, P., Rychlik, I., Volf, J., Creach, P., Smith, A., Colles, F. and Leterrier, C. (2019). Influence of the microbiota-gut-brain axis on behaviour and welfare in farm animals: A review. Physiology & Behaviour, 210, p.112658.

Kregel K. (2002). Heat shock proteins: Modifying factors in physiological stress responses and acquired thermotolerance. Journal of Applied Physiology. 92:2177–2186.

Lagadic, H., Faure, J. M., Mills, A. D., & Williams, J. B. (1990). Effects of blood sampling on plasma concentrations of corticosterone and glucose in laying hens caged in groups. British Poultry Science, 31(4), 823-829.

Lane J (2006) Can non-invasive glucocorticoid measures be used as reliable indicators of stress in animals? Animal Welfare (South Mimms, England) 15, 331–342.

Lara, L. J., & Rostagno, M. H. (2013). Impact of heat stress on poultry production. Animals, 3(2), 356-369.

Launay, F., Mills, A. D., & Faure, J. M. (1993). Effects of test age, line and sex on tonic immobility responses and social reinstatement behaviour in Japanese quail Coturnix japonica. Behavioural Processes, 29(1-2), 1-16.

LeDoux, J. (1996). Emotional networks and motor control: A fearful view. Progress in Brain Research, 107, 437–446.

Lester, D. (1968). Effects of habituation to fear on the exploratory behaviour of rats. Nature, 220(5170), 932-932.

Li, L.L., Hou, Z.P., Li, T.J., Wu, G.Y., Huang, R.L., Tang, Z.R., Yang, C.B., Gong, J., Yu, H., Kong, X.F. and Pan, E. (2008). Effects of dietary probiotic supplementation on ileal digestibility of nutrients and growth performance in 1- to 42-day-old broilers. Journal of the Science of Food and Agriculture, 88(1), pp.35-42.

Li, C.L., Wang, J., Zhang, H.J., Wu, S.G., Hui, Q.R., Yang, C.B., Fang, R.J. and Qi, G.H. (2019). Intestinal morphologic and microbiota responses to dietary Bacillus spp. in a broiler chicken model. Frontiers in physiology, 9, p.1968.

Lian, P., Braber, S., Garssen, J., Wichers, H. J., Folkerts, G., Fink-Gremmels, J., & Varasteh, S. (2020). Beyond heat stress: intestinal integrity disruption and mechanism-based intervention strategies. Nutrients, 12(3), 734.

Liew, P. K., Zulkifli, I., Hair-Bejo, M., Omar, A. R., & Israf, D. A. (2003). Effects of early age feed restriction and heat conditioning on heat shock protein 70 expression, resistance to infectious bursal disease, and growth in male broiler chickens subjected to heat stress. Poultry Science, 82(12), 1879-1885.

Lim, H. H., Jenkins, O. H., Myers, M. W., Miller, J. M., & Altschuler, R. A. (1993). Detection of HSP 72 synthesis after acoustic overstimulation in rat cochlea. Hearing Research, 69(1-2), 146-150.

Lin, Y.; Weisdorf, D.J.; Solovey, A.; Hebbel, R.P. (2000). Origins of circulating endothelial cells and endothelial outgrowth from blood. Journal of Clinical Investigation. 105, 71–77.

Lindqvist, C., & Jensen, P. (2009). Domestication and stress effects on contrafreeloading and spatial learning performance in red jungle fowl (Gallus gallus) and White Leghorn layers. Behavioural Processes, 81(1), 80-84.

Liu, W. C., Pan, Z. Y., Zhao, Y., Guo, Y., Qiu, S. J., Balasubramanian, B., & Jha, R. (2022). Effects of heat stress on production performance, redox status, intestinal morphology and barrier-related gene expression, cecal microbiome, and metabolome in indigenous broiler chickens. Frontiers in Physiology, 13, 761.

Lokapirnasari, W. P., Agustono, B., Al Arif, M. A., Maslachah, L., Chandra, E. H., & Yulianto, A. B. (2022). Effect of probiotic and Moringa oleifera extract on performance, carcass yield, and mortality of Peking duck. Veterinary World, 15(3), 694.

Lukkes, J. L., Mokin, M. V., Scholl, J. L., & Forster, G. L. (2009). Adult rats exposed to early-life social isolation exhibit increased anxiety and conditioned fear behaviour, and altered hormonal stress responses. Hormones and Behaviour, 55(1), 248-256.

Lutz, C., Well, A., & Novak, M. (2003). Stereotypic and self-injurious behaviour in rhesus macaques: a survey and retrospective analysis of environment and early experience. American Journal of Primatology: Official Journal of the American Society of Primatologists, 60(1), 1-15.

Lutful Kabir, S. M. (2009). The role of probiotics in the poultry industry. International Journal of Molecular Sciences, 10(8), 3531-3546.

Lynch, T. E., & Speake, D. W. (1978). Eastern wild turkey behavioural responses induced by sonic boom. In Effects of noise on wildlife (pp. 47-61). Academic Press.

Lyons, D. M., Price, E. O., & Moberg, G. P. (1988). Individual differences in temperament of domestic dairy goats: constancy and change. Animal Behaviour, 36(5), 1323-1333.

Macrì, S., Pasquali, P., Bonsignore, L.T., Pieretti, S., Cirulli, F., Chiarotti, F., Laviola, G., (2007). Moderate neonatal stress decreases within-group variation in behavioural, immune and HPA responses in adult mice. PLoS One 2, e1015.

Mack, L. A., Felver-Gant, J. N., Dennis, R. L., & Cheng, H. W. (2013). Genetic variations alter production and behavioural responses following heat stress in 2 strains of laying hens. Poultry Science, 92(2), 285-294.

Mader, T. L., et al. (2009). Environmental stress in confined beef cattle. Journal of Animal Science, 87(14 Suppl), E64-E71.

Marasco, V., Robinson, J., Herzyk, P., & Spencer, K. A. (2012). Pre-and post-natal stress in context: effects on the stress physiology in a precocial bird. Journal of Experimental Biology, 215(22), 3955-3964.

Manteuffel, G., Puppe, B., & Schön, P. C. (2004). Vocalization of farm animals as a measure of welfare. Applied Animal Behaviour Science, 88(1-2), 163-182.

Marin, R.H.; Freytes, P.; Guzman, D.; Bryan Jones, R. (2001). Effects of an acute stressor on fear and on the social reinstatement responses of domestic chicks to cage mates and strangers. Applied Animal Behaviour Science. Sc. 71, 57–66.

Maki, J. J., Klima, C. L., Sylte, M. J., & Looft, T. (2019). The microbial pecking order: Utilization of intestinal microbiota for poultry health. Microorganisms, 7(10), 376.

Mayer, E.A.; Knight, R.; Mazmanian, S.K.; Cryan, J.F.; Tillisch, K. (2014). Gut microbes and the brain: Paradigm shift in neuroscience. Journal of Neuroscience. 34, 15490–15496

Maxwell, M. H. (1993). Avian blood leucocyte responses to stress. World's Poultry Science Journal, 49(1), 34-43.

McCrea, B. A., Tonooka, K. H., VanWorth, C., Atwill, E. R., Schrader, J. S., & Boggs, C. L. (2006). Prevalence of Campylobacter and Salmonella species on farm, after transport, and at processing in specialty market poultry. Poultry Science, 85(1), 136-143.

McEwen, B. S. (2008). Understanding the potency of stressful early life experiences on brain and body function. Metabolism, 57, S11-S15.

McFarlane, J. M., Curtis, S. E., Shanks, R. D., & Carmer, S. G. (1989). Multiple concurrent stressors in chicks.: 1. Effect on weight gain, feed intake, and behaviour. Poultry Science, 68(4), 501-509.

Meimandipour, A., Soleimanifarjam, A., Hair-Bejo, M., Shuhaimi, M., Azhar, K., Nateghi, L., Rasti, B. and Yazid, A.M. (2010). Efficacy of lactobacilli to normalize production of corticosterone induced by unpleasant handling of broilers. South African Journal of Animal Science, 40(4), pp.327-333.

Mench, J. A. (2002). Broiler breeders: feed restriction and welfare. World's Poultry Science Journal, 58(1), 23-29.

Mendl, M., Neville, V., & Paul, E. S. (2022). Bridging the gap: Human emotions and animal emotions. Affective Science, 3(4), 703-712.

Meuser, V.; Weinhold, L.; Hillemacher, S.; Tiemann, I. (2021). Welfare-related behaviours in chickens: Characterisation of fear and exploration in local and commercial chicken strains. Animals. 11, 679

Mielnik, M.; Craig, J.V.; Milliken, G.A. (1992). Research note: Beak trimming and holding time effects on fearfulness of pullets as cyestimated by tonic immobility. Poultry Science. 71, 391–394

Mignon-Grasteau, S., & Minvielle, F. (2003). Relation between tonic immobility and production estimated by factorial correspondence analysis in Japanese quail. Poultry Science, 82(12), 1839-1844.

Mignon-Grasteau, S., Moreri, U., Narcy, A., Rousseau, X., Rodenburg, T. B., Tixier-Boichard, M., & Zerjal, T. (2015). Robustness to chronic heat stress in laying hens: a meta-analysis. Poultry Science, 94(4), 586-600.

Miller, K. A., Garner, J. P., & Mench, J. A. (2006). Is fearfulness a trait that can be measured with behavioural tests? A validation of four fear tests for Japanese quail. Animal Behaviour, 71(6), 1323-1334.

Mills, A. D., & Faure, J. M. (1991). Divergent selection for duration of tonic immobility and social reinstatement behaviour in Japanese quail (Coturnix coturnix japonica) chicks. Journal of Comparative Psychology, 105(1), 25.

Mills, A. D., & Faure, J. M. (1986). Apparent absence of sex differences in the behaviour of Japanese quail chicks in four behavioural tests. IRCS Medical Science: Psychology & Psychiatry.

Mills, D. S., & Nicol, C. J. (1990). Tonic immobility in spent hens after catching and transport. The Veterinary Record, 126(9), 210-212.

Mitchell, M. A., & Kettlewell, P. J. (1998). Physiological stress and welfare of broiler chickens in transit: solutions not problems!. Poultry Science, 77(12), 1803-1814.

Mitchell, M. A., & Kettlewell, P. J. (2009). Welfare of poultry during transport-a review.

Moberg, G. P. (2000). Biological response to stress: implications for animal welfare. In The biology of animal stress: Basic principles and implications for animal welfare. (pp. 1-21). Wallingford UK: CABI publishing.

Moe, R.O., Guemene, D., Bakken, M., Larsen, H.J.S., Shini, S., Lervik, S., Skjerve, E., Michel, V. and Tauson, R. (2010). Effects of housing conditions during the rearing and laying period on adrenal reactivity, immune response and heterophil to lymphocyte (H/L) ratios in laying hens. Animal, 4(10), pp.1709-1715.

Moeser, A. J., Pohl, C. S., & Rajput, M. (2017). Weaning stress and gastrointestinal barrier development: Implications for lifelong gut health in pigs. Animal Nutrition, 3(4), 313-321.

Mohamed, R.A., Abou-Ismail, U.A., Shukry, M. (2016). Effects of different monochromatic LED light colours on fear reactions and physiological responses in Mulard ducks. Animal Production Science. 57, 1128–1136.

Mohammed, A., Mahmoud, M., Murugesan, R., & Cheng, H. W. (2021). Effect of a synbiotic supplement on fear response and memory assessment of broiler chickens subjected to heat stress. Animals, 11(2), 427.

Molnár, A. K., Podmaniczky, B., Kürti, P., Tenk, I., Glávits, R., Virág, G. Y., & Szabó, Z. S. (2011). Effect of different concentrations of Bacillus subtilis on growth performance, carcase quality, gut microflora and immune response of broiler chickens. British Poultry Science, 52(6), 658-665.

Morimoto, R. I. (1993). Cells in stress: transcriptional activation of heat shock genes. Science, 259(5100), 1409-1410.

Morimoto, R. I. (1998). Regulation of the heat shock transcriptional response: cross talk between a family of heat shock factors, molecular chaperones, and negative regulators. Genes & Development, 12(24), 3788-3796.

Mormède P. (1995). Le stress: interaction animal-homme-environnement. Cah. Agric; 4:275–86.

Mormède, P., Andanson, S., Aupérin, B., Beerda, B., Guémené, D., Malmkvist, J., Manteca, X., Manteuffel, G., Prunet, P., van Reenen, C.G. and Richard, S. (2007). Exploration of the hypothalamic–pituitary–adrenal function as a tool to evaluate animal welfare. Physiology and Behaviour, 92(3), pp.317-339.

Mota-Rojas, D., Maurice Broom, D., Orihuela, A., Velarde, A., Napolitano, F., and Alonso-Spilsbury, M. (2020). Effects of human-animal relationship on animal productivity and welfare. Journal of Animal Behaviour and Biometeorology.

Mountzouris, K. C., Balaskas, C., Xanthakos, I., Tzivinikou, A., and Fegeros, K. (2009). Effects of a multi-species probiotic on biomarkers of competitive exclusion efficacy in broilers challenged with Salmonella enteritidis. British Poultry Science, 50(4), 467-478.

Mousa-Balabel, T. M., and Mohamed, R. A. (2011). Behavioural and physiological changes of Pekin ducks after transportation. Kafrelsheikh Veterinary Medical Journal, 9(2), 19-44.

Möstl E., Rettenbacher S., Palme R. (2005). Measurement of corticosterone metabolites in birds' droppings: an analytical approach.Annals of the New York Academy of Sciences 1046, 17–34.

Mueller, S., Taddei, L., Albiker, D., Kreuzer, M., Siegrist, M., Messikommer, R. E., & Gangnat, I. D. M. (2020). Growth, carcass, and meat quality of 2 dual-purpose chickens and a layer hybrid grown for 67 or 84 D compared with slow-growing broilers. Journal of applied poultry research, 29(1), 185-196.

Mundim, A.V., da Silva Martins, J.M., Marchini, C.F.P., Guimarães, E.C., Gotardo, L.R.M., Rinaldi, F.P., Bueno, J.P.R., de Mattos Nascimento, M.R.B. and de Sousa, G.M.R. (2017). Effect of age and cyclical heat stress on the serum biochemical profile of broiler chickens. Semina: Ciências Agrárias, 38(3), pp.1383-1392.

Murray, B. A., Soos, C., & Machin, K. L. (2023). The effects of pre-hatch elevated corticosterone and post-hatch restrictive food availability on the HPA axis development of mallard ducks (Anas platyrhynchos). General and Comparative Endocrinology, 342, 114339.

Myers, M. W., Quirk, W. S., Rizk, S. S., Miller, J. M., and Altschuler, R. A. (1992). Expression of the major mammalian stress protein in the rat cochlea following transient ischemia. The Laryngoscope, 102(9), 981-987.

Najafi, P.; Zulkifli, I.; Amat Jajuli, N.; Farjam, A.S.; Ramiah, S.K.; Amir, A.A.; O'Reily, E.; Eckersall, D. (2015). Environmental temperature and stocking density effects on acute phase proteins, heat shock protein 70, circulating corticosterone and performance in broiler chickens. International Journal of Biometeorology. 59, 1577–1583.

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. Livestock Science, 130(1-3), 57-69.

Neely, J. G., Thompson, A. M., and Gower, D. J. (1991). Detection and localization of heat shock protein 70 in the normal guinea pig cochlea. Hearing research, 52(2), 403-406.

Nelson, J. R., Settar, P., Berger, E., Wolc, A., O'Sullivan, N., and Archer, G. S. (2020). Brown and white egg-layer strain differences in fearfulness and stress measures. Applied Animal Behaviour Science, 231, 105087.

Newberry, R. C. (1999). Exploratory behaviour of young domestic fowl. Applied animal behaviour science, 63(4), 311-321.

Nicol, C. J. (1992). Effects of environmental enrichment and gentle handling on behaviour and fear responses of transported broilers. Applied Animal Behaviour Science, 33(4), 367-380.

Nicol, C. J. (2015). The behavioural biology of chickens. Cabi.

Nicholson, J. K., and Wilson, I. D. (2003). Understanding'global'systems biology: metabonomics and the continuum of metabolism. Nature Reviews Drug Discovery, 2(8), 668-676.

Nowak, R., and Boivin, X. (2015). Filial attachment in sheep: Similarities and differences between ewe-lamb and human-lamb relationships. Applied Animal Behaviour Science, 164, 12-28.

Oakley, B.B., Lillehoj, H.S., Kogut, M.H., Kim, W.K., Maurer, J.J., Pedroso, A., Lee, M.D., Collett, S.R., Johnson, T.J. and Cox, N.A. (2014). The chicken gastrointestinal microbiome. FEMS microbiology letters, 360(2), pp.100-112.

Oguntunji A. O., Oladejo O. A., Ayoola M. O., Oluwatomini I., Oriye L. O. & Egunjobi I. M. (2019). Genetic variation in physiological adaptation of local, exotic and crossbred ducks to heat stress in a tropical environment. Genetic and Biodiversity Journal, 3(1), 35-45..

Odendaal, J. S. J. (1998). Animal welfare in practice. Applied Animal Behaviour Science, 59(1-3), 93-99.

Oh, S. H., Yu, W. S., Song, B. H., Lim, D., Koo, J. W., Chang, S. O., and Kim, C. S. (2000). Expression of heat shock protein 72 in rat cochlea with cisplatin-induced acute ototoxicity. Acta Oto-Laryngologica, 120(2), 146-150.

Oladokun, S., and Adewole, D. (2023). The effect of Bacillus subtilis and its delivery route on hatch and growth performance, blood biochemistry, immune status, gut morphology, and microbiota of broiler chickens. Poultry Science, 102(4), 102473.

Olnood, C. G., Beski, S. S., Choct, M., and Iji, P. A. (2015). Novel probiotics: Their effects on growth performance, gut development, microbial community and activity of broiler chickens. Animal Nutrition, 1(3), 184-191.

Ossenkopp, K. P. (1980). The open-field test as a rapid and sensitive behavioural measure in White Peking ducklings Anas platyrhynchos. Bird Behaviour, 2(1), 23-35.

Parois, S., Calandreau, L., Kraimi, N., Gabriel, I., and Leterrier, C. (2017). The influence of a probiotic supplementation on memory in quail suggests a role of gut microbiota on cognitive abilities in birds. Behavioural Brain Research, 331, 47-53.

Patterson, J. A., and Burkholder, K. M. (2003). Application of prebiotics and probiotics in poultry production. Poultry Science, 82(4), 627-631.

Paterson, A. M., and Pearce, G. P. (1992). Growth, response to humans and corticosteroids in male pigs housed individually and subjected to pleasant, unpleasant or minimal handling during rearing. Applied Animal Behaviour Science, 34(4), 315-328.

Pearce, G. P., Paterson, A. M., and Pearce, A. N. (1989). The influence of pleasant and unpleasant handling and the provision of toys on the growth and behaviour of male pigs. Applied Animal Behaviour Science, 23(1-2), 27-37.

Penha Filho, R. A. C., Díaz, S. J. A., Fernando, F. S., Chang, Y. F., Andreatti Filho, R. L., and Junior, A. B. (2015). Immunomodulatory activity and control of Salmonella Enteritidis colonization in the intestinal tract of chickens by Lactobacillus based probiotic. Veterinary Immunology and Immunopathology, 167(1-2), 64-69.

Peng, S., Wang, X., Wang, Y., Lv, T., Zhao, H., Wang, Y., Zhu, S., Qiu, H., Zeng, J., Dai, Q. and Lin, Q. (2021). Effects of dietary Bacillus and non-starch polysaccharase on the intestinal microbiota and the associated changes on the growth performance, intestinal morphology, and serum antioxidant profiles in ducks. Frontiers in Microbiology, 12, p.786121.

Perai, A. H., Kermanshahi, H., Moghaddam, H. N., and Zarban, A. (2015). Effects of chromium and chromium+ vitamin C combination on metabolic, oxidative, and fear responses of broilers transported under summer conditions. International Journal of Biometeorology, 59, 453-462.

Perai, A. H., Kermanshahi, H., Nassiri Moghaddam, H., and Zarban, A. (2014). Effects of supplemental vitamin C and chromium on metabolic and hormonal responses, antioxidant status, and tonic immobility reactions of transported broiler chickens. Biological Trace Element Research, 157, 224-233.

Perals, D., Griffin, A. S., Bartomeus, I., and Sol, D. (2017). Revisiting the open-field test: what does it really tell us about animal personality?. Animal Behaviour, 123, 69-79.

Pichova, K., Nordgreen, J., Leterrier, C., Kostal, L., and Moe, R. O. (2016). The effects of food-related environmental complexity on litter directed behaviour, fear and exploration of novel stimuli in young broiler chickens. Applied Animal Behaviour Science, 174, 83-89.

Piersma, T., Reneerkens, J., and Ramenofsky, M. (2000). Baseline corticosterone peaks in shorebirds with maximal energy stores for migration: a general preparatory mechanism for rapid behavioural and metabolic transitions? General and Comparative Endocrinology, 120(1), 118-126.

Pinillos, R. G., Appleby, M. C., Manteca, X., Scott-Park, F., Smith, C., and Velarde, A. (2016). One Welfare–a platform for improving human and animal welfare. Veterinary Record, 179(16), 412-413.

Plesset, J., Palm, C., and McLaughlin, C. S. (1982). Induction of heat shock proteins and thermotolerance by ethanol in Saccharomyces cerevisiae. Biochemical and Biophysical Research communications, 108(3), 1340-1345.

Powell, S. B., Geyer, M. A., Gallagher, D., & Paulus, M. P. (2004). The balance between approach and avoidance behaviours in a novel object exploration paradigm in mice. Behavioural brain research, 152(2), 341-349.

Price E. O. and Orihuela A. (2010). Conducta animal aplicada al cuidado y producción pecuaria. Universidad Autónoma del Estado de Morelos, Morelos (Mexico).

Puetz, L.C., Delmont, T.O., Aizpurua, O., Guo, C., Zhang, G., Katajamaa, R., Jensen, P., Gilbert, M.T.P. (2021). Gut microbiota linked with reduced fear of humans in Red Junglefowl has implications for early domestication. Advanced Genetics. 2, 2100018.

Rahimi, S. H., and Khaksefidi, A. (2006). A comparison between the effects of a probiotic (Bioplus 2B) and an antibiotic (virginiamycin) on the performance of broiler chickens under heat stress condition. Iranian Journal of Veterinary Research, 7(3), 23-28.

Rankin, C.H., Abrams, T., Barry, R.J., Bhatnagar, S., Clayton, D.F., Colombo, J., Coppola, G., Geyer, M.A., Glanzman, D.L., Marsland, S. and McSweeney, F.K. (2009). Habituation revisited: an updated and revised description of the behavioural characteristics of habituation. Neurobiology of Learning and Memory, 92(2), pp.135-138.

Ratner, S. C. (1967). Comparative aspects of hypnosis. In J. E. Gordon (Ed.), Handbook of clinical and experimental hypnosis (pp. 550–587). New York: Macmillan.

Rault, J. L., Waiblinger, S., Boivin, X., and Hemsworth, P. (2020). The power of a positive human–animal relationship for animal welfare. Frontiers in Veterinary Science, 7, 590867.

Réale, D., Reader, S. M., Sol, D., McDougall, P. T., and Dingemanse, N. J. (2007). Integrating animal temperament within ecology and evolution. Biological Reviews, 82(2), 291-318.

Rehman, H. U., Vahjen, W., Awad, W. A., and Zentek, J. (2007). Indigenous bacteria and bacterial metabolic products in the gastrointestinal tract of broiler chickens. Archives of Animal Nutrition, 61(5), 319-335.

Reiter, K., Zernig, F., and Bessei, W. (1997). Effect of water bath and free range on behaviour and feathering in Pekin, Muscovy, and Mulard duck. In Proceedings of the 11th European Symposium on Waterfowl, Nantes, France (pp. 224-229).

Remignon, H., Mills, A. D., Guemene, D., Desrosiers, V., Garreau-Mills, M., Marche, M., and Marche, G. (1998). Meat quality traits and muscle characteristicsin high or low fear lines of Japanese quails (Coturnix japonica) subjected to acute stress. British Poultry Science, 39(3), 372-378.

Renaudeau, D., Collin, A., Yahav, S., De Basilio, V., Gourdine, J. L., & Collier, R. J. (2012). Adaptation to hot climate and strategies to alleviate heat stress in livestock production. Animal, 6(5), 707-728.

Rivarola, M. A., and Suárez, M. M. (2009). Early maternal separation and chronic variable stress in adulthood changes the neural activity and the expression of glucocorticoid receptor in limbic structures. International Journal of Developmental Neuroscience, 27(6), 567-574.

Riber, A. B., Wichman, A., Braastad, B. O., and Forkman, B. (2007). Effects of broody hens on perch use, ground pecking, feather pecking and cannibalism in domestic fowl (Gallus gallus domesticus). Applied Animal Behaviour Science, 106(1-3), 39-51.

Rodenburg, T. B., Tuyttens, F. A. M., De Reu, K., Herman, L., Zoons, J., and Sonck, B. (2008). Welfare assessment of laying hens in furnished cages and non-cage systems: an on-farm comparison. Animal Welfare, 17(4), 363-373.

Romero, L. M., and Reed, J. M. (2005). Collecting baseline corticosterone samples in the field: is under 3 min good enough? Comparative Biochemistry and Physiology Part A: Molecular and Integrative Physiology. 140(1), 73-79

Rothman, J. E. (1989). Polypeptide chain binding proteins: catalysts of protein folding and related processes in cells. Cell, 59(4), 591-601.

Rowland, I., Gibson, G., Heinken, A., Scott, K., Swann, J., Thiele, I., and Tuohy, K. (2018). Gut microbiota functions: metabolism of nutrients and other food components. European Journal of Nutrition, 57, 1-24.

Rusch, J. A., Layden, B. T., & Dugas, L. R. (2023). Signalling cognition: the gut microbiota and hypothalamic-pituitary-adrenal axis. Frontiers in Endocrinology, 14, 1130689.

Rushen, J., Taylor, A. A., and de Passillé, A. M. (1999). Domestic animals' fear of humans and its effect on their welfare. Applied Animal Behaviour Science, 65(3), 285-303.

Rybarczyk, P., Koba, Y., Rushen, J., Tanida, H., and de Passillé, A. M. (2001). Can cows discriminate people by their faces?. Applied Animal Behaviour Science, 74(3), 175-189.

Sachser, N., and Kaiser, S. (1996). Prenatal social stress masculinizes the females' behaviour in guinea pigs. Physiology and behaviour, 60(2), 589-594.

Salem, H.M.; Alqhtani, A.H.; Swelum, A.A.; Babalghith, A.O.; Melebary, S.J.; Soliman, S.M.; Khafaga, A.F.; Selim, S.; El-Saadony, M.T.; El-Tarabily, K.A. (2022). Heat stress in poultry with particular reference to the role of probiotics in its amelioration: An updated review. Journal of Thermal Biology, 108, 103302.

Salvatierra, N.A., Cid, M.P., Arce, A., 2009. Neonatal acute stress by novelty in the absence of social isolation decreases fearfulness in young chicks. Stress 12, 328–335.

Sampson, T. R., and Mazmanian, S. K. (2015). Control of brain development, function, and behaviour by the microbiome. Cell, Host and Microbe, 17(5), 565-576.

Sapolsky, R. M. (2015). Stress and the brain: individual variability and the inverted-U. Nature neuroscience, 18(10), 1344-1346.

Sapolsky, R. M., Romero, L. M., & Munck, A. U. (2000). How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. Endocrine reviews, 21(1), 55-89.

Sargeant, A. B., and Eberhardt, L. E. (1975). Death feigning by ducks in response to predation by red foxes (Vulpes fulva). American Midland Naturalist, 108-119.

Satterlee, D. G., and Johnson, W. A. (1988). Selection of Japanese quail for contrasting blood corticosterone response to immobilization. Poultry Science, 67(1), 25-32.

Satterlee, D. G., Jones, R. B., and Ryder, F. H. (1993). Short-latency stressor effects on tonic immobility fear reactions of Japanese quail divergently selected for adrenocortical responsiveness to immobilization. Poultry Science, 72(6), 1132-1136.

Scanes, C. G. (2016). Biology of stress in poultry with emphasis on glucocorticoids and the heterophil to lymphocyte ratio. Poultry Science, 95(9), 2208-2215.

Scanes, C. G., Hurst, K., Thaxton, Y., Archer, G. S., and Johnson, A. (2020). Effect of transportation and shackling on plasma concentrations of corticosterone and heterophil to lymphocyte ratios in market weight male turkeys in a commercial operation. Poultry Science, 99(1), 546-554.

Schütz, K. E., Forkman, B., and Jensen, P. (2001). Domestication effects on foraging strategy, social behaviour and different fear responses: a comparison between the red junglefowl (Gallus gallus) and a modern layer strain. Applied Animal Behaviour Science, 74(1), 1-14.

Shahir, M. H., Afsarian, O., Ghasemi, S., and Tellez, G. (2014). Effects of dietary inclusion of probiotic or prebiotic on growth performance, organ weight, blood parameters and antibody titers against influenza and newcastle in broiler chickens. International Journal of Poultry Science, 13(2), 70.

Shamsuddin, M. T & Idris, L. H. (2014). Physical meat quality of pekin duck reared in open-house free-rangeand close-house systems. 9th Proceedings of the Seminar on Veterinary Sciences, 24 - 28 February 2014. Pg 75-79.

Shang, Y., Kumar, S., Oakley, B., and Kim, W. K. (2018). Chicken gut microbiota: importance and detection technology. Frontiers in Veterinary Science, 5, 254.

Shannon, G., McKenna, M.F., Angeloni, L.M., Crooks, K.R., Fristrup, K.M., Brown, E., Warner, K.A., Nelson, M.D., White, C., Briggs, J. and McFarland, S. (2016). A synthesis of two decades of research documenting the effects of noise on wildlife. Biological Reviews, 91(4), pp.982-1005.

Sheng-Qiu, T., Xiao-Ying, D., Chun-Mei, J., Jing-Jing, P., Shan-Shan, L., and Jin-Ding, C. (2013). Effect of Bacillus subtilis natto on growth performance in Muscovy ducks. Brazilian Journal of Poultry Science, 15, 191-197.

Shehata, A. M., Saadeldin, I. M., Tukur, H. A., Habashy, W. S. (2020). Modulation of heat-shock proteins mediates chicken cell survival against thermal stress. Animals, 10, 2407.

Shi, D., Bai, L., Qu, Q., Zhou, S., Yang, M., Guo, S., Li, Q. and Liu, C. (2019). Impact of gut microbiota structure in heat-stressed broilers. Poultry science, 98(6), pp.2405-2413.

Siegel, H. S. (1971). Adrenals, stress and the environment. World's Poultry Science Journal, 27(4), 327-349.

Siegel, P. B. (1993). Behaviour-genetic analyses and poultry husbandry. Poultry Science, 72(1), 1-6.

Siegel, H.S. (1995). Stress, strains and resistance. Br. Poult. Sci. 36, 3–22

Silva, V. K., Silva, J. D. T. D., Gravena, R. A., Marques, R. H., Hada, F. H., and Moraes, V. M. B. D. (2010). Yeast extract and prebiotic in pre-initial phase diet for broiler chickens raised under different temperatures. Revista Brasileira de Zootecnia, 39, 165-174.

Simitzis, P.E., Kalogeraki, E., Goliomytis, M., Charismiadou, M.A., Triantaphyllopoulos, K., Ayoutanti, A., Niforou, K., Hager-Theodorides, A.L. and Deligeorgis, S.G. (2012). Impact of stocking density on broiler growth performance, meat characteristics, behavioural components and indicators of physiological and oxidative stress. British Poultry Science, 53(6), pp.721-730.

Sluyter, F., Korte, S. M., Bohus, B., and Van Oortmerssen, G. A. (1996). Behavioural stress response of genetically selected aggressive and nonaggressive wild house mice in the shock-probe/defensive burying test. Pharmacology Biochemistry and Behaviour, 54(1), 113-116.

Smith, K. C., and Pierdon, M. K. (2023). Impact of mechanical vs. manual catching on stress, fear, and carcass quality in slower growing broilers. Journal of Applied Animal Welfare Science, 1-8.

Soleimani, A. F., Zulkifli, I., Omar, A. R., and Raha, A. R. (2011). Physiological responses of 3 chicken breeds to acute heat stress. Poultry Science, 90(7), 1435-1440.

Soleimani, A. F., Zulkifli, I., Hair-Bejo, M., Omar, A. R., and Raha, A. R. (2012). The role of heat shock protein 70 in resistance to Salmonella enteritidis in broiler chickens subjected to neonatal feed restriction and thermal stress. Poultry Science, 91(2), 340-345.

Sohail, M. U., Ijaz, A., Yousaf, M. S., Ashraf, K., Zaneb, H., Aleem, M., and Rehman, H. (2010). Alleviation of cyclic heat stress in broilers by dietary supplementation of mannan-oligosaccharide and Lactobacillus-based probiotic: Dynamics of cortisol, thyroid hormones, cholesterol, C-reactive protein, and humoral immunity. Poultry science, 89(9), 1934-1938.

Sohail, M. U., Z. U. Rahman, A. Ijaz, M. S. Yousaf, K. Ashraf, T. Yaqub, H. Zenab, H. Anwar, and H. Rehman. (2011). Single or combined effects of mannan-oligosaccharides and probiotics supplements on the total oxidants, total antioxidants, enzymatic antioxidants, liver enzymes and serum trace minerals in cyclic heat stressed broilers. Poultry Science. 90:2573–2577.

Sohail, M.U., Hume, M.E., Byrd, J.A., Nisbet, D.J., Ijaz, A., Sohail, A., Shabbir, M.Z. and Rehman, H., (2012). Effect of supplementation of prebiotic mannan-oligosaccharides and probiotic mixture on growth performance of broilers subjected to chronic heat stress. Poultry Science, 91(9), pp.2235-2240.

Sol, D., Griffin, A. S., Bartomeus, I., and Boyce, H. (2011). Exploring or avoiding novel food resources? The novelty conflict in an invasive bird. PloS one, 6(5), e19535.

Solomon, J. K. Q., Austin, R., Cumberbatch, R. N., Gonsalves, J., and Seaforth, E. (2006). A comparison of live weight and carcass gain of Pekin, Kunshan and Muscovy ducks on a commercial ration. Livestock Research for Rural Development, 18(11), 154.

Song, J., Xiao, K., Ke, Y.L., Jiao, L.F., Hu, C.H., Diao, Q.Y., Shi, B. and Zou, X.T. (2014). Effect of a probiotic mixture on intestinal microflora, morphology, and barrier integrity of broilers subjected to heat stress. Poultry Science, 93(3), pp.581-588.

Song, J., Jiao, L. F., Xiao, K., Luan, Z. S., Hu, C. H., Shi, B., and Zhan, X. A. (2013). Cello-oligosaccharide ameliorates heat stress-induced impairment of intestinal microflora, morphology and barrier integrity in broilers. Animal Feed Science and Technology, 185(3-4), 175-181.

Spencer, K.A., Evans, N. P., Monaghan, P. (2009). Postnatal stress in birds: a novel model of glucocorticoid programming of the hypothalamic-pituitary-adrenal axis. Endocrinology 150:1931–1934.

St-Pierre, N. R., et al. (2003). Invited review: Integrating quantitative findings from multiple studies using mixed model methodology. Journal of Dairy Science, 86(12), 4074-4085.

Stadelman, W. J. (1958a). The effect of sounds of varying intensity on hatchability of chicken egg. Poultry Science, 37(1), 166-169.

Stadelman, W. J. (1958b). Observations with growing chickens on the effects of sounds of varying intensities. Poultry Science, 37(4), 776-779.

Stanley, D., Hughes, R. J., Geier, M. S., & Moore, R. J. (2016). Bacteria within the gastrointestinal tract microbiota correlated with improved growth and feed conversion: challenges presented for the identification of performance enhancing probiotic bacteria. Frontiers in microbiology, 7, 175834.

Staudacher, H.M., Scholz, M., Lomer, M.C., Ralph, F.S., Irving, P.M., Lindsay, J.O., Fava, F., Tuohy, K. and Whelan, K. (2021). Gut microbiota associations with diet in irritable bowel syndrome and the effect of low FODMAP diet and probiotics. Clinical Nutrition, 40(4), pp.1861-1870.

Stringfellow, K., Caldwell, D., Lee, J., Mohnl, M., Beltran, R., Schatzmayr, G., Fitz-Coy, S., Broussard, C. and Farnell, M. (2011). Evaluation of probiotic administration on the immune response of coccidiosis-vaccinated broilers. Poultry Science, 90(8), pp.1652-1658

Suarez, S. D., and Gallup, G. G. (1982). Open-field behaviour in chickens: The experimenter is a predator. Journal of Comparative and Physiological Psychology, 96(3), 432.

Sudo, N., Chida, Y., Aiba, Y., Sonoda, J., Oyama, N., Yu, X.N., Kubo, C. and Koga, Y. (2004). Postnatal microbial colonization programs the hypothalamic–pituitary–adrenal system for stress response in mice. The Journal of Physiology, 558(1), pp.263-275.

Sudo, N. (2016). Effects of gut microbiota on stress response and behavioural phenotype of the host. Brain and Nerve. Shinkei Kenkyu No Shinpo 68, 595–605.

Sugahara, K., Inouye, S., Izu, H., Katoh, Y., Katsuki, K., Takemoto, T., Shimogori, H., Yamashita, H. and Nakai, A. (2003). Heat shock transcription factor HSF1 is required for survival of sensory hair cells against acoustic overexposure. Hearing Research, 182(1-2), pp.88-96.

Sumanu, V. O., Aluwong, T., Ayo, J. O., and Ogbuagu, N. E. (2019). Evaluation of changes in tonic immobility, vigilance, malondialdehyde, and superoxide dismutase in broiler chickens administered fisetin and probiotic (Saccharomyces cerevisiae) and exposed to heat stress. Journal of Veterinary Behaviour, 31, 36-42.

Surai, P. F., and Fisinin, V. I. (2016). Vitagenes in poultry production: Part 2. Nutritional and internal stresses. World's Poultry Science Journal, 72(4), 761-772.

Taleb, M., Brandon, C. S., Lee, F. S., Lomax, M. I., Dillmann, W. H., and Cunningham, L. L. (2008). Hsp70 inhibits aminoglycoside-induced hair cell death and is necessary for the protective effect of heat shock. Journal of the Association for Research in Otolaryngology, 9, 277-289.

Taleb, M., Brandon, C. S., Lee, F. S., Harris, K. C., Dillmann, W. H., and Cunningham, L. L. (2009). Hsp70 inhibits aminoglycoside-induced hearing loss and cochlear hair cell death. Cell Stress and Chaperones, 14, 427-437.

Talling, J. C., Lines, J. A., Wathes, C. M., and Waran, N. K. (1998). The acoustic environment of the domestic pig. Journal of Agricultural Engineering Research, 71(1), 1-12.

Tanida, H., and Nagano, Y. (1998). The ability of miniature pigs to discriminate between a stranger and their familiar handler. Applied Animal Behaviour Science, 56(2-4), 149-159.

Taranto, M.P., Medici, M., Perdigon, G., Holgado, A.R., Valdez, G.F. (1998). Evidence for hypocholesterolemic effect of Lactobacillus reuteri in hypercholesterolemic mice. Journal of Dairy Science, 81, 2336–2340.

Taylor, P. S., Hemsworth, P. H., & Rault, J. L. (2022). Environmental complexity: additional human visual contact reduced meat chickens’ fear of humans and physical items altered pecking behaviour. Animals, 12(3), 310.

Tetel, V., Van Wyk, B., and Fraley, G. S. (2022). Sex differences in glucocorticoid responses to shipping stress in Pekin ducks. Poultry Science, 101(1), 101534.

Tennessen, J. B., Parks, S. E., and Langkilde, T. (2014). Traffic noise causes physiological stress and impairs breeding migration behaviour in frogs. Conservation Physiology, 2(1), cou032.

Teo, A. Y., and Tan, H. M. (2007). Evaluation of the performance and intestinal gut microflora of broilers fed on corn-soy diets supplemented with Bacillus subtilis PB6 (CloSTAT). Journal of Applied Poultry Research, 16(3), 296-303.

Thoo, L., Noti, M., and Krebs, P. (2019). Keep calm: the intestinal barrier at the interface of peace and war. Cell Death and Disease, 10(11), 849.

Tiemann, I., Hillemacher, S., & Wittmann, M. (2020). Are dual-purpose chickens twice as good? Measuring performance and animal welfare throughout the fattening period. Animals, 10(11), 1980.

Tilbrook, A. J., and C. R. Ralph. "Hormones, stress and the welfare of animals." Animal Production Science 58.3 (2017): 408-415.

Tsiouris, V., Georgopoulou, I., Batzios, C., Pappaioannou, N., Ducatelle, R., and Fortomaris, P. (2018). Heat stress as a predisposing factor for necrotic enteritis in broiler chicks. Avian Pathology, 47(6), 616-624.

Val-Laillet, D., Tallet, C., Guérin, C., and Meunier-Salaün, M. C. (2013). Behavioural reactivity, social and cognitive abilities of Vietnamese and Pitman–Moore weaned piglets. Applied Animal Behaviour Science, 148(1-2), 108-119.

Van der Eijk, J. A., Rodenburg, T. B., de Vries, H., Kjaer, J. B., Smidt, H., Naguib, M., Lammers, A. (2020). Early-life microbiota transplantation affects behavioural responses, serotonin and immune characteristics in chicken lines divergently selected on feather pecking. Scientific Reports, 10(1), 2750.

Vasaï, F., Brugirard Ricaud, K., Bernadet, M. D., Cauquil, L., Bouchez, O., Combes, S., and Davail, S. (2014). Overfeeding and genetics affect the composition of intestinal microbiota in Anas platyrhynchos (Pekin) and Cairina moschata (Muscovy) ducks. The Federation of European Microbiological Societies (FEMS) Microbiology Ecology, 87(1), 204-216.

Vasaï, F., Ricaud, K.B., Cauquil, L., Daniel, P., Peillod, C., Gontier, K., Tizaoui, A., Bouchez, O., Combes, S. and Davail, S. (2014). Lactobacillus sakei modulates mule duck microbiota in ileum and ceca during overfeeding. Poultry Science, 93(4), pp.916-925.

Veissier, I., and Boissy, A. (2007). Stress and welfare: Two complementary concepts that are intrinsically related to the animal's point of view. Physiology and Behaviour, 92(3), 429-433.

Vuong, H.E.; Yano, J.M.; Fung, T.C.; Hsiao, E.Y. (2017). The microbiome and host behaviour. Annual Review of Neuroscience, 40, 21–49.

Vosmerova, P.; Chloupek, J.; Bedanova, I.; Chloupek, P.; Kruzikova, K.; Blahova, J.; Vecerek, V. (2010). Changes in selected biochemical indices related to transport of broilers to slaughterhouse under different ambient temperatures. Poultry Science. 89, 2719–2725.

Voslarova, E., Chloupek, P., Vosmerova, P., Chloupek, J., Bedanova, I., and Vecerek, V. (2011). Time course changes in selected biochemical indices of broilers in response to pretransport handling. Poultry Science, 90(10), 2144-2152.

Waiblinger, S., Hosey, G., and Melfi, V. (2019). Agricultural animals. Anthrozoology: Human-Animal Interactions in Domesticated and Wild Animals, 32-58.

Waiblinger, S., Boivin, X., Pedersen, V., Tosi, M. V., Janczak, A. M., Visser, E. K., and Jones, R. B. (2006). Assessing the human–animal relationship in farmed species: a critical review. Applied Animal Behaviour Science, 101(3-4), 185-242.

Waite, D. W., and Taylor, M. W. (2015). Exploring the avian gut microbiota: current trends and future directions. Frontiers in Microbiology, 6, 673.

Wang, J. Q., Yin, F. G., Zhu, C., Yu, H., Niven, S. J., De Lange, C. F. M., and Gong, J. (2012). Evaluation of probiotic bacteria for their effects on the growth performance and intestinal microbiota of newly-weaned pigs fed fermented high-moisture maize. Livestock Science, 145(1-3), 79-86.

Waynert, D. F., Stookey, J. M., Schwartzkopf-Genswein, K. S., Watts, J. M., and Waltz, C. S. (1999). The response of beef cattle to noise during handling. Applied Animal Behaviour Science, 62(1): 27-42

Weaver, I. C., Cervoni, N., Champagne, F. A., D'Alessio, A. C., Sharma, S., Seckl, J. R., Meaney, M. J. (2004). Epigenetic programming by maternal behaviour. Nature Neuroscience, 7(8), 847-854.

Wemesfelder, F., and Birke, L. (1997). Environmental challenge. In M. C. Appleby and B. O.

Weeks, C. A., Tuyttens, F. A., and Grandin, T. (2019). Poultry handling and transport. In Livestock handling and transport (pp. 404-426). Wallingford UK: CABI.

Wen, C., Wei, S., Zong, X., Wang, Y., and Jin, M. (2021). Microbiota-gut-brain axis and nutritional strategy under heat stress. Animal Nutrition, 7(4), 1329-1336.

Woolf, N.K., Bixby, J.L., Capranica, R.R., (1976). Prenatal experience and avian development: brief auditory stimulation accelerates the hatching of Japanese quail. Science,194, 959–960.

Wu, L., Guo, X., & Fang, Y. (2012). Effect of diet dilution ratio at early age on growth performance, carcass characteristics and hepatic lipogenesis of Pekin ducks. Brazilian Journal of Poultry Science, 14, 43-49.

Xi, Y., Shuling, N., Kunyuan, T., Qiuyang, Z., Hewen, D., ChenCheng, G., Tianhe, Y., Liancheng, L. and Xin, F. (2019). Characteristics of the intestinal flora of specific pathogen free chickens with age. Microbial Pathogenesis, 132, pp.325-334.

Yadav, S., and Jha, R. (2019). Strategies to modulate the intestinal microbiota and their effects on nutrient utilization, performance, and health of poultry. Journal of Animal Science and Biotechnology, 10(1), 1-11.

Yan, C., Xiao, J., Li, Z., Liu, H., Zhao, X., Liu, J., Chen, S. and Zhao, X. (2021). Exogenous fecal microbial transplantation alters fearfulness, intestinal morphology, and gut microbiota in broilers. Frontiers in Veterinary Science, 8, p.706987.

Yanagi Jr, T., Xin, H., and Gates, R. S. (1998). Modeling partial surface evaporative cooling of chickens. In 2001 ASAE Annual Meeting (p. 1). American Society of Agricultural and Biological Engineers.

Yazhini, P., Visha, P., Selvaraj, P., Vasanthakumar, P., & Chandran, V. (2018). Dietary encapsulated probiotic effect on broiler serum biochemical parameters. Veterinary world, 11(9), 1344.

Yegani, M., and Korver, D. R. (2008). Factors affecting intestinal health in poultry. Poultry science, 87(10), 2052-2063.

Yi, D., Hou, Y., Tan, L., Liao, M., Xie, J., Wang, L., Gong, J. (2016). N-acetylcysteine improves the growth performance and intestinal function in the heat-stressed broilers. Animal Feed Science and Technology, 220, 83-92.

Yildrim, A.; Kraimi, N.; Constantin, P.; Mercerand, F.; Leterrier, C. (2020). Effects of tryptophan and probiotic supplementation on growth and behaviour in quail. Poultry Science. 99, 5206–5213.

Yoshida, N., Kristiansen, A., and Liberman, M. C. (1999). Heat stress and protection from permanent acoustic injury in mice. Journal of Neuroscience, 19(22), 10116-10124.

Yoshida, N., and Liberman, M. C. (2000). Sound conditioning reduces noise-induced permanent threshold shift in mice. Hearing research, 148(1-2), 213-219.

Yu, H., Bao, E.D., Zhao, R.Q., Lv, Q.X. (2007). Effect of transportation stress on heat shock protein 70 concentration and mRNA expression in heart and kidney tissues and serum enzyme activities and hormone concentrations of pigs. American Journal of Veterinary Research, 68, 1145–1150.

Zakari, F.O., Uchendu, C., Buba, W., Idoga, E.S., Ibrahim, M.J. (2019). Graded levels of Bactofort® modulates tonic immobility and behavioural vigilance responses of broiler chickens during the cold-dry (Harmattan) season. Journal of Veterinary Behaviour. 32, 49–56.

Zaytsoff, S. J., Montina, T., Boras, V. F., Brassard, J., Moote, P. E., Uwiera, R. R., & Inglis, G. D. (2022). Microbiota transplantation in day-old broiler chickens ameliorates necrotic enteritis via modulation of the intestinal microbiota and host immune responses. Pathogens, 11(9), 972.

Zeng, T., Li, J.J., Wang, D.Q., Li, G.Q., Wang, G., Lu, L.Z. (2014). Effects of heat stress on antioxidant defense system, inflammatory injury, and heat shock proteins of Muscovy and Pekin ducks: Evidence for differential thermal sensitivities. Cell Stress Chaperones,19, 895–901.

Zhang, L., Yue, H.Y., Zhang, H.J., Xu, L., Wu, S.G., Yan, H.J., Gong, Y.S. and Qi, G.H. (2009). Transport stress in broilers: I. Blood metabolism, glycolytic potential, and meat quality. Poultry Science, 88(10), pp.2033-2041.

Zhang, P., Yan, T., Wang, X., Kuang, S., Xiao, Y., Lu, W., and Bi, D. (2017a). Probiotic mixture ameliorates heat stress of laying hens by enhancing intestinal barrier function and improving gut microbiota. Italian Journal of Animal Science, 16(2), 292-300.

Zhang, L., Wang, X., Li, J., Zhu, X., Gao, F., and Zhou, G. (2017b). Creatine monohydrate enhances energy status and reduces glycolysis via inhibition of AMPK pathway in pectoralis major muscle of transport-stressed broilers.

Zhang, C., Zhao, X. H., Yang, L., Chen, X. Y., Jiang, R. S., Jin, S. H., & Geng, Z. Y. (2017c). Resveratrol alleviates heat stress-induced impairment of intestinal morphology, microflora, and barrier integrity in broilers. Poultry science, 96(12), 4325-4332. Journal of Agricultural and Food Chemistry, 65(32), 6991-6999.

Zhang, Q., Li, J., Wang, G., Wang, L., Zhang, Z., Fang, Z., Lin, Y., Xu, S., Feng, B., Zhuo, Y. and Hua, L. (2022). The replacement of bacitracin methylene disalicylate with *Bacillus subtilis* PB6 in the diet of male Cherry Valley Ducks reduces the feed conversion ratio by improving intestinal health and modulating gut microbiota. Poultry Science, 101(11), 102155.

Zhao, F. Q., Zhang, Z. W., Qu, J. P., Yao, H. D., Li, M., Li, S., and Xu, S. W. (2014). Cold stress induces antioxidants and Hsps in chicken immune organs. Cell stress and chaperones, 19, 635-648.

Zhu, Z., Chen, Y., Huang, Z., Zhang, Y., Xu, Q., Tong, Y., Zhai, F., Chang, G. and Chen, G., 2014. Effects of transport stress and rest before slaughter on blood parameters and meat quality of ducks. Canadian Journal of Animal Science, 94(4), pp.595-600.

Zhu, L., Liao, R., Wu, N., Zhu, G., and Yang, C. (2019). Heat stress mediates changes in fecal microbiome and functional pathways of laying hens. Applied microbiology and biotechnology, 103, 461-472.

Zhu, C., Xu, W., Tao, Z., Song, W., Liu, H., Zhang, S., & Li, H. (2020). Effects of rearing conditions and sex on cecal microbiota in ducks. Frontiers in Microbiology, 11, 565367.

Zidar, J., Balogh, A., Favati, A., Jensen, P., Leimar, O., and Løvlie, H. (2017). A comparison of animal personality and coping styles in the red junglefowl. Animal Behaviour, 130, 209-220.

Zmora, N., Suez, J., and Elinav, E. (2019). You are what you eat: diet, health and the gut microbiota. Nature reviews Gastroenterology and Hepatology, 16(1), 35-56.

Zulkifli, I. (2013). Review of human-animal interactions and their impact on animal productivity and welfare. Journal of Animal Science and Biotechnology, 4(1), 1-7.

Zulkifli, I., Abdullah, N., Azrin, N. M., and Ho, Y. W. (2000). Growth performance and immune response of two commercial broiler strains fed diets containing Lactobacillus cultures and oxytetracycline under heat stress conditions. British Poultry Science, 41(5), 593-597.

Zulkifli I., Akmal, A. F. Soleimani, M. A. Hossain, and E. A. Awad. (2018). Effects of low-protein diets on acute phase proteins and heat shock protein 70. Poultry Science. Vol. 97, 1306-1314.

Zulkifli, I., Akmal, A. F., Soleimani, A. F., Hossain, M. A., and Awad, E. A. (2018). Effects of low-protein diets on acute phase proteins and heat shock protein 70 responses, and growth performance in broiler chickens under heat stress condition. Poultry Science, 97(4), 1306-1314.

Zulkifli, I., Al-Aqil, A., Omar, A.R., Sazili, A.Q., and Rajion, M.A. (2008). Housing system affects stress and fear reactions, and meat quality of broiler chickens subjected to road transportation. In Proceedings of the XXIII World's Poultry

Congress 2008, p. 380. World's Poultry Science Association, Odijk, The Netherlands.

Zulkifli, I., Al-Aqil, A., Omar, A. R., Sazili, A. Q., & Rajion, M. A. (2009). Crating and heat stress influence blood parameters and heat shock protein 70 expression in broiler chickens showing short or long tonic immobility reactions. Poultry Science, 88(3), 471-476.

Zulkifli, I., Che Norma, M.T., Chong, C.H., Loh, T.C. (2000). Heterophil/lymphocyte and tonic immobility reactions to preslaughter handling in broiler chickens treated with ascorbic acid. Poultry Science. 79, 402–406.

Zulkifli, I., Dass, R. T., and Norma, M. C. (1999). Acute heat-stress effects on physiology and fear-related behaviour in red jungle fowl and domestic fowl. Canadian Journal of Animal Science, 79(2), 165-170.

Zulkifli, I., Dunnington, E. A., Gross, W. B., & Siegel, P. B. (1994a). Food restriction early or later in life and its effect on adaptability, disease resistance, and immunocompetence of heat - stressed dwarf and nondwarf chickens. British Poultry Science, 35(2), 203-213.

Zulkifli, I., Dunnington, E. A., Gross, W. B., & Siegel, P. B. (1994b). Inhibition of adrenal steroidogenesis, food restriction and acclimation to high ambient temperatures in chickens. British Poultry Science, 35(3), 417-426.

Zulkifli, I., Gilbert, J., Liew, P. K., and Ginsos, J. (2002a). The effects of regular visual contact with human beings on fear, stress, antibody and growth responses in broiler chickens. Applied Animal Behaviour Science, 79(2), 103-112.

Zulkifli, I., Norma, M. C., Israf, D. A., and Omar, A. R. (2002b). The effect of early-age food restriction on heat shock protein 70 response in heat-stressed female broiler chickens. British Poultry Science, 43(1), 141-145.

Zulkifli, I., and Nor Azah, A. S. (2004). Fear and stress reactions, and the performance of commercial broiler chickens subjected to regular pleasant and unpleasant contacts with human being. Applied Animal Behaviour Science, 88(1-2), 77-87.

Zulkifli I., Norbaiyah B., Cheah Y. W., Soleimani A. F., Sazili A. Q., Goh Y. M. and Rajion M. A. (2010). A note on heat shock protein 70 expression in goats subjected to road transportation under hot, humid tropical conditions. The Animal Consortium, 4:6, pp 973–976.

Zulkifli I., Liew P.K., Israf D.A., Omar A.R., Hair-Bejo M. (2003). Effects of early age feed restriction and heat conditioning on heterophil/lymphocyte ratios, heat shock protein 70 expression and body temperature of heat-stressed broiler chickens. Journal of Thermal Biology. 28 (2003) 217–222

Zulkifli, I., and Siegel, P. B. (1995). Is there a positive side to stress? World's Poultry Science Journal, 51(1), 63-76.

Zulkifli, I., Rahayu, H. S., Alimon, A. R., Vidyadaran, M. K., and Babjee, S. A. (2001). Responses of choice-fed red jungle fowl and commercial broiler chickens offered a complete diet, corn and soybean. Asian-Australasian Journal of Animal Sciences, 14(12), 1758-1762.