GENE EXPRESSION OF SOME ECONOMIC TRAITS RELATED TO HEAT STRESS IN CAMEL

By

HEND ABOU ELAZM EL SAYED IBRAHIM

B.Sc. Agric. Sc. (Genetics), Ain Shams University, 2003
M.Sc. Agric. Sc. (Genetics), Ain Shams University, 2009

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This thesis for Ph.D. degree has been approved by:

Dr. Ashgan Abed El-Meged El-Sayd ……..
Prof. Emeritus of Genetics, Faculty of Agriculture, Saba Basha, Alexandria University

Dr. Essmat Bakry Abdalla ……..
Prof. Emeritus of Animal Physiology, Faculty of Agriculture, Ain Shams University

Dr. Aly Z. E. Abdelsalam ……..
Prof. Emeritus of Genetics, Faculty of Agriculture, Ain Shams University

Dr. Alia A. M. El-Seoudy ……..
Prof. Emeritus of Genetics, Faculty of Agriculture, Ain Shams University

Date of Examination: 17 / 3 / 2016

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HEND ABOU ELAZM EL SAYED IBRAHIM

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Under the supervision of:

Dr. Alia A. M. El-Seoudy

Prof. Emeritus of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University (Principal Supervisor)

Dr. Aly Zein El Abidin Abdelsalam

Prof. Emeritus of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University

Dr. Asmaa Mohamed Abou Shady

Lecturer of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University

ABSTRACT

Hend Abou Elazm ELsayed Ibrahim. Gene Expression of some Economic Traits Related to Heat Stress in Camel, Unpublished Ph.D. Thesis, Department of Genetics Faculty of Agriculture, Ain Shams University, 2016.

Camels have a number of adaptations to help them to survive the most successfully in such dry and arid climates. Camels have an exceptional ability to adapt to desert lifestyle with remarkable physiological characteristics such as fluctuating body temperature from 34°C to 41.7°C throughout the day, tolerating water loss greater than 30%, and capability of drinking 100 liters of water in as little as 10 minutes. In the present study, global methylation was assessed in camels exposed to two climatic changes; cold and heat. Data obtained indicated the differences in the methylation of these animals, which, in turn, reflects a difference in gene expression patterns based on epigenetics. In winter season, the majority of samples enrolled in this study were hypermethylated while in summer season, half of the samples were hypomethylated and the rest were hypermethylated where there was a significant difference between samples in winter and summer with p-value < 0.05 (p = 0.020). Meanwhile, a significant difference between samples in winter and summer on the level of gene expression of (leptin and IGF) with p-value < 0.05 (p = 0.000) has been obtained. The seasonal variation affected the levels of plasma proteins such as Immunoglobulin (γ-globulin), Post-Transferrin, Transferrin (β-globulin) and α-globulin (slow and fast). This study was concerned mainly with to genes (lipten and IGF), which are related to milk production, as an example of economic traits. The results obtained indicated that the reduced

temperature (winter) has caused the whole genome of camels to hypomethylate while the elevated temperature caused hypermethylation of the whole genome. Real time- RCR data confirmed the epigenetics data with regards the two genes under study. We concluded that heat stress could regulate the gene expression on the epigenetics level.

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LIST OF APREVIATIONS

bp	base pairs
cDNA	complementary deoxyribonucleic acid
Ct	cycle threshold
DNA	deoxyribonucleic acid
DNas	deoxyribonuclease
EDTA	Ethylenediaminetetraacetatic acid
IGF	insulin like growth factor
kb	kilobase pairs
MW	Molecular weight
kDa	kilo-Dalton
PCR	polymerase chain reaction
RNA	ribonucleic acid
RT-PCR	reverse transcription PCR
SDS	sodium dodecyl sulfate
PAGE	polyacrylamide gel electrophoresis

INTRODUCTION

Camels, valuable in desert regions throughout the world because of their ability to carry heavy loads over long distances without food or water, are divided into two species, the one-humped dromedary and the two-humped Bactrian camel (**Faye, 2015**). The total population of camel in the world is estimated as 14 million, of which, Africa has 78.22%, Asia has 21.71%, and the remaining world has only 0.07% (**FAO, 2012**). Developing countries have 99.03% of this camel population. However, in recent years, camels have decreased from 141.000 to 110.000 (**FAO, 2011**). The camel has received very little attention as compared to other species of domesticated animals of Egypt. Camel body temperature keeps fluctuating from 34°C to 41.7°C (93°F-107°F) (**Soliman, 2015**).

Camels play an important socio-economic role within the pastoral and agricultural system in the dry and semidry zones of Asia and Africa. Camels are economically important animals in Egypt where they are dual purpose animals (meat and milk). The analysis of chemical composition of camel milk showed that the total protein contents ranged from 2.4% to 5.3% and it is divided into casein and whey proteins (**Othman *et al.*, 2016**).

The dromedary (*Camelus dromedaries*), also called Arabian camel or one humped camel, was domesticated in the Arabian Peninsula. All camels have 74 chromosomes with a very similar morphology. The Arabian camel genome is the first mammalian genome to be sequenced in the Middle East (**Soliman 2015)**.

In Egypt, the camel population was about 120.000 head (**SADS, 2009**). The main camel breeds reared in Egypt are Maghrabi, Falahy, Sudany, Somali and Mowaled (**Mahrous *et al.*, 2005**). Egyptian

INTRODUCTION

camels are important animals because they are dual purpose animals for production of (meat and milk). In the Nile Valley and Delta, they are mainly raised for meat production whereas in the desert, they are raised equally for meat and milk production, some labors and transport (**Alam *et al.*, 2015**).

The one-humped camel (*Camelus dromedaries*) is a crucial animal that can survive in hot and arid environment. Camels are considered as an elemental part in the sophistication and farming of many Arab countries; the unique physiological system of camel allows them to fill an important position in the desert farming (**Megersa *et al.*, 2012; Volpato *et al.*, 2015**).

Many studies have reported, that camel milk has very high concentration of mono-and polyunsaturated fatty acids, serum albumin, lactoferrin, immunoglobulin's, vitamins C, and E, lysozyme, manganese and iron, as well as the hormone insulin (**Kaskous, 2015**). The most important component of camel milk is water content which is about 84-90% (**Saitmuratova *et al.*, 2015**). It has the distinctive composition that differs from other animal's milk. It contains lower fat, cholesterol, and lactose (**Mohamed *et al.*, 2005; Al-Humaid *et al.*, 2010**). Camels can produce more milk and for longer period of time than any other dairy animal reared under the same harsh conditions (**Farah *et al.*, 2007**). Milk yield also varies with breed, stage of lactation and management condition as for the other dairy animals (**Farah *et al.*, 2004; Faye, 2005**). Although most Camel milk production can significantly be improved (**Iqbal *et al.*, 2009**).

Leptin is the hormone product of the obeseity (LEP) gene. The role of leptin as a lipostatic signal in regulating whole-body energy metabolism makes it one of the best physiological markers of body

weight and food intake (**Tahmoorespur and Shojaei, 2013**). Leptin, the hormone that regulate hunger, has been found to change on seasonal manner (**Miller *et al.*, 2002).** The heat stresses can upregulate leptin and other diet- related hormones such as adiponectin and insulin (**Morera *et al.*, 2012).** Serum leptin concentration in dromedary is associated with age, sex, and season as evidenced and positively correlated with hump and body weight gains during rainy season, where good pasture conditions are available. Camels have been widely acknowledged for their versatility and capabilities to cope with and to adapt harsh and stressful situations in frequently drought stricken areas (**Ahmed and Ibrahim, 2009**). Leptin affects energy homeostasis by decreasing food intake and by up-regulating fatty acid oxidation and down-regulating lipogenesis in peripheral tissues (**Rabe *et al.* 2008**). Leptin is a hormone predominantly secreted from white adipose tissue and performs important roles in controlling body weight, milk production, feed intake, immune function and reproduction (**Block *et al.*, 2001**).

Insulin-like growth factor-I (IGF-I) is a key stimulator of growth and development in animals. The production of IGF-I in the body is controlled by growth hormone (GH) and nutritional status. Growth hormone, a hormone that itself plays an essential role in postnatal growth in animals, IGF-I gene expression is affected by nutritional intake and growth hormone (GH) stimulates IGF-I gene expression, and for this relationship, most of the growth-stimulating effects of GH are believed to be mediated by IGF-I. Increased nutritional intake is often associated with increased IGF-I concentration in the circulation and increased growth, whereas decreased nutritional intake usually leads to decreased IGF-I concentration in the blood and growth retardation, a potential mechanism for reserving energy for the brain during undernutrition **(Wang, 2005**). IGF-I has been hypothesized to be a biomarker which mediates the roles of physical activity (and other factors) on body composition and health