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REVIEW ARTICLE
INSULIN GENE AND INSULIN HORMONE IN BROILER CHICKEN ROSS 308: A REVIEW

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Abstract

Insulin hormone considered as one of the peptide hormones, it secreted from Beta cell of Langerhans Island of pancreas. It composed of 51 amino acid distributed in two chin A and B. Insulin hormone stimulate cells of liver, muscle, other adipose tissue too, by taken the advantage of available glucose to be used as a source of energy in cell, so it will not allowed adipose tissue to be used to form energy that by inhibiting secreting of glucagon hormone from alpha cell of pancreas gland as in natural case for cellular metabolisms. And it contributes to storage glycogen in hepatic cells and muscle to be used in case or when blood insulin deficiency happened. Genes located on chicken chromosomes called as Somatotropic Axis Gene, very impotent to produce many hormones effect directly on growth and development chicken. Insulin gene is one of these important candidate gene. Polymorphisms of insulin gene coded to insulin hormone INSg related with many physiological and productive performance traits as growth, body development, and body composition and with their receptors within plasma for many somatic cells in Adipose tissue cells, Muscle tissue cells and Hepatic cells. Now a day it is easy to used genetic markers as polymorphisms of insulin hormone gene related with chicken traits in selection program of broiler

Keywords: Insulin gene, Insulin hormone, glucagon , Ross308, SNPs.

Introduction

Genes are defined as frequencies of nucleotides interconnected by phosphodiester bond with lengths ranged from 500-1000 base pairs or more for each gene, and it's regulated sequentially on the double helixes of DNA by bonds (H-band) creating the overall structure of DNA. These genes usually start with a code (Start Codon-TAA-TGA-TAG) as well as end with a code (Stop Codon-TAA-TGA-TAG) which reflects the starting and ending point of the active gene space. (Watson *et al*., 1987). Due to the variety of chromosomes (that carrying genes) and its lengths, the genes were distributed in a variety of ways and the number of genes was differ from one organism to another. Generally, the numbers of these genes ranged from 50000-100000 genes as these numbers are decreased successively base to the degree and extent of evolution of living organisms whereas in some types of prokaryotic organisms including leachates, the genes number was four or five genes only. These different genes have been divided into many species according to their function and the resulting expression products as it is known that genes control a large number of basic physical functions and mechanisms of regulation through the provision of work program or codes that enables the cells to manufacture the proteins needed by cells to accomplish their tasks since the products of gene expression are the translation of the codes and converted into amino acids linked in the form of multiple peptide chains and thus composed of proteins. The most common and interpretation genes for the scientists and researchers are: Regulatory genes which are responsible for the mechanism of coordination and regulation of gene work in general, House Keeping Genes which maintain the continuity of the work of genes according to the sequence of natural, Psedo Genes which represents one of the types of genes that do not detect or express any protein and Candidate Genes that relies on linking and finding the relationship between the genetic variation of genes with unspecified importance the genotypes of the studied character. Usually, the candidate genes are often used as information base used to identify the functions of the biological function of large number of gene (Biological Genes Functional) and study its effect on many of the characteristics or diseases prepared for study Tomson *et al*. (1989). The logical explanation behind the focus on the difference at the level of allele was due to the probability of contributing to the emergence of multiple mutations in different kinds, was a direct effect on the functional paths of genes in general, and is often used to know what is related to research studies on the purposes and functions of genes in addition to their control over the attributes associated with them as well as developmental studies on genetics, as they provide greater potential for studying more than one type of alleles. The selection of candidate genes was based on biological and physiological knowledge as well as available theoretical information on biologics. Recently, the rapid development of molecular tools have greatly helped in understanding the mechanics and identification of larger and more important sites in the genome(Beuzon *et al*., 2000). Scientific research that has been based on the full scale of the genome and quantitative traits location maps have been considered as joint detection factors to examine the interactions and differences within the genome. Thus new regions and sites located within the vicinity of these candidate genes could be detected which included GH, GHSR, Lipten, and Insulin, (Kadlec *et al*., 2011). Whil chicken genome is with 2.8 milion of Single Nucleotid Polymorphisames (SNPs) (Wong *et al*., 2004), That could be used as genetic markers (SNPs) in selection programs (Lei *et al*., 2007).

Is Insulin gene important? And why?

The insulin gene is one of the most important species that represents the vertebral column of candidate genes according to the genetic analysis used in the detection of complex relationships and links to a large number of traits in different organisms Souza (2004). According to studies and research experiments on human being, it was found that insulin gene plays an important role in the coordination and regulation of biological functions in the peptide new rode generative glands, in addition to its functional roles inside and outside the various body cells. Moreover, it gave a classification of two types of pathogenic conditions which

results in a pathogenesis of diabetes, the first type called insulin-sensitive diabetes (Diabetes Type1) and has been identified by a single site and by the mono allele (I) on the human insulin gene, which provides direct susceptibility to diabetes. The other site on the gene included the second type, called the potential insulin risk of diabetes (Risk Diabetes Type2), which is the carrier of triple alleles (III), that may cause the risk of diabetes as well as the possibility of the emergence of associated diseases, including PCOS (Polycystic ovaries-PCOS) resulting from Hyper insulinemic and the human insulin gene is often associated with the presence of allele I and thus stimulates the appearance of the disease since the early stages of infancy. VNTR-Variable Number of Tandem Repeats were used to detect the relative positions of candidate genes due to they are molecular markers that has a set of multiple and duplicate alleles in a single site as well as its ability to identify sites where losses are occurring in some repeated units and therefore these markers were associated with diabetes in the early stages of growth and the underlying structures of metabolic processes in adult Metabolic Phenotypes, which are major causes of the diseases such as adiposity, hyperglycemia, blood pressure, Insulin sensitivity (Thomson *et al*., 1989, 2003, Bennett *et al*., 2004).

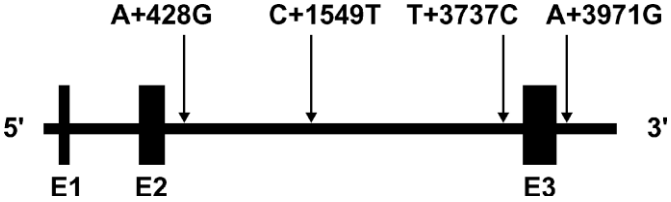
Insulin gene (INSg), Is it the seam in all living organisms?

Most of the reviews of previous and current research studies that dealt with topics related to the study of insulin gene and its similar factors between the various types of eukcaryotic organisms from the year of 1988 to our current date, the references indicated that there was similarity in the same number of constituent units of each Insulin and its similar factors among the studied vertebrates by conducting a series of experiments with the availability of evidence and relying on the use of modern technologies for the purpose of understanding the molecular life evolution as well as observations of behavioral performance, in conjunction with scientific revolution and recent developments in the fields of biochemistry and molecular sciences and gradually, research has taken a new approach that focuses on studying the possibility of evolutionary possibilities in the origins of the species belonging to the family of insulin (Insulin family), which under the name of many different types of insulin and its various objects, which can be expressed as one of the active polypeptide groups of insulin, which forms the head of the pyramid and the other followed factors like insulin (IGF1-II- Insulin Like GROTH factor) and semi insulin correlated with peptides (INS4gene) or EPIL-Early placenta insulin like peptide, Relaxin H1-H2, INSL5-Insulin like protein, and other species found in mammalian animals. These associated peptide species are not the only ones detected in vertebrates, there are another species of insulin that correlated with non-vertebrates such as Insulin3gene (LIRP-Locust Insulin related peptide) which found in insects and (MIP-Mollusean insulin related peptide) in molluscs as well as other species in unicellular organisms Chunxia *et al*. (2005).

Where is the gene of Insulin Hormone located in chicken chromosomes?

The whole number of chromosomes in chicken are 39 pairs, 38 of them classified as Autosomes and the last pair (Z,W) classified as the sex chromosomes, and all chicken chromosomes consist of two kind the (Micro) the small and (Macro) the biggest according to its size with length ranged between 0.2-9 micron (Burt, 2005).

It was found that the insulin gene in domestic birds takes an intermediate position and is portable on the long arm within the fifth chromosome of the body and depend on position (NCBI -Gene Banke) according to the frequency (AY438372) with length of (4.074 bp) which represents the total length of the insulin gene, which in turn consists of (4) exons and (3) introns. The insulin gene also contains four sites representing multiple manifestations of single nucleotides (SNPs) and distributed as (4) SNPs, where the first three of the second intron are placed and ranked respectively according to the frequencies of the mutations (A + 428G, C + 1549T and T + 3737C, while the last one takes the position of the third intron (Qiu *et al.*, (2006). (Fig. 2-1).



Qiu *et al*. (2006)

Fig. 2-1 : Insulin gene and sites of emerging mutations

One of the most important of these sites is the third with frequency that represents the location of the mutation (T + 3737C) within the second intron which represents the subject of the study by taking an individual pattern to study and clarify the relationship based on the effect of the location of the mutation on the studied traits as well as its relation to the formed genotypes and the effect on the improvement of early genetic selection of later breeds commensurate with the efficient production performance of commercially and locally desirable strains. Several studies have demonstrated gene structure including finding obtained from a research experiment included two communities one human and the other domestic birds, particularly chickens, for the purpose of identifying insulin gene from multiple phenotypic changes where it was found that the human insulin gene contained 56 recurrences of the single-nucleotide multiple phenotypic identified on the human genetic map of the gene. However, the chicken community (24) recurrences of the polypeptide single nucleotides and on this basis the insulin gene was considered a pleiotropic gene, which made it as one of the most suitable genes in determining the economic characteristics of the birds (Stead *et al*., 2003; Dupont *et al*., 1999).

Relationship between insulin gene and some economic trait in poultry

A research experiment was conducted to study the plurality of single nucleotides of insulin gene in chickens and their relation to a number of body composition traits such as speed growth, muscle composition, and fat deposition which represent the basic points to start the economical genetic improvement in poultry (Qiu *et al*., 2006) whereas the insulin gene has main role in the overall metabolism in the hepatic, muscle and fatty cells in the body, the study showed a significant impact of insulin gene on early growth and weight increase under effect of the multiple phenotypic for bilateral mutation together (A + 3971G, C + 1549T), (A+428G cipytonehp elpitlum fo smrof llA . ylevitcepser (C7373+Tو were showed insignificant relationship with deposition of

abdominal fat character while the individual form that represents the position of the third mutation (T + 3737C) was found to have a significant effect with the character of the small length intestine, hence insulin is a clear contribution to the understanding and knowledge of the genetic mechanism of its action and underlying the attributes of growth and the formation of physical muscles by linking the studied traits with determination of positions and forms of individual and common patterns to the multiple phenotypic of the gene and to the formation of improved productive herds with high genetic efficiency.

In a study that included a number of local Vietnamese chicken strains with cobb500, Khoa *et al*. (2012) was intended to link a number of economic characteristics (high body growth rate and quality of meat produced) to a number of individual phenotypic patterns (PCR-RFLP). The results showed that each of the multiple forms shown by the sites of bilateral mutations (A + 3971G and C + 1549T) gave high significant increase in both weight and speed characters and this has been reflected in the productivity of an improved quality meat to suit consumer tastes as well as the role of the mutation site shown by the third phenotype (T + 3737C), which focused on the characteristic length of the small intestine and thus took aside the physiological appearance with genetic basis by contributing to better utilization of food absorption processes, thus reflecting the mechanism of building and sustainable development of the body in various cells. The local species used in the experiment represented a unique genetically modified basis that have different characteristics from the commercial herds and the most of the traits to be improved are also related to the expression of their efficiency with the genetic origins that have emerged from them.

Dupont *et al*. (2009) demonstrated that insulin gene and its receptors control the general metabolism of the body and its genetic expression in both muscle and liver cells of the chickens. After making several comparisons between different types of vertebrates, chicken was found to have similar concentrations to the other species (including humans and mice) in terms of distribution within the blood circulation, except to maintain the increase in the level of sugar (glucose) in blood plasma which may be due to the low sensitivity of chickens to external insulin (Exogen insulin). The low sensitivity can be attributed to the difference in insulin receptors and their signals among domestic birds and other types of vertebrates. SHC and IRS-1 are the most important types of receptors found in the muscle and liver tissues of chickens in addition to other species with unknown genetic expression such as IRSS, ERK and AKT. At the same time, insulin signals and receptors in chicken hepatic cells were found to be similar to other vertebrates, except for muscle cell signals, which were completely different. It was observed that leg muscles in chickens differed with others in the early stages of growth and formation through differing insulin signals, including TR TRS P13K. The efficiency and activity of the indicator P13K in chickens was about 30 times higher than that of mice. The excessive activity of this indicator in muscle cells of chickens is responsible and contributes to reducing the sensitivity of external insulin compared to other studied vertebrates which are usually affected by the inhibition of that indicator. Chicken is also characterized by its high resistance to any increase of insulin signals and in general, insulin has important roles and multiple effects in chickens as in the other vertebrates. It is used in most metabolic processes, including anabolic metabolism, utilization, absorption, transfer of glucose, glycogen synthesis, control of the levels of fat and enzymes in the liver (control of the level of liver lipo-genic enzymes), amino acid transport, and protein synthesis. As well, insulin gene stimulates growth and cellular division and reduces apoptosis.

The main purpose of the insulin gene activity is centered around a set of target tissues and the most important are muscle, fatty and liver tissues to regulate the balance of glucose inside it as well as the main control on the functions of different cells of the body is the central nervous system (CNS-Control Nervous System) where insulin was found to have a number of important receptors that are distributed within specific areas of the brain, showing that it has the evidence of actual participation in a variety of physiological functions. It is concentrated in a number of areas of the hypothalamus and it was directly related to the processes of regulation and balance of energy and its distribution within the body in human communities and domestic birds and these signals and receptors share the processes of enhancing understanding, perception, sensory and cognitive selection. Moreover, they may be affected by a host of inhibitory factors such as glutamate and GABA receptors, causing loss of memory-enhancing sensory receptors, resulting in a reverse reaction and the possibility of aging and Alzheimer's disease for human societies (Zhao *et al*., 2004).

The factor N-3PUFA is one of the most important developmental and evolutionary factors related to the promotion of health aspects and affects the regulatory processes of the metabolism of fat, glucose and proteins through the extent of the impact of insulin sensitivity and through a research experiment, a group of male chickens (Ross308 strain) were fed for three weeks on known diets chemical structures and the quality of its constituents, included vital factors (LC-PUFA and n-3PUFA), sources of protein (22% isoproteic) and energy (54-12% kg/MJ), which contained various sources of oils such as sunflower oil that rich in ALA-Alinolenic acid and fish oil which is rich in LC-PUFA acid. The obtained results showed that the growth performance of the body and major thoracic muscles were improved. It was also found in intravenous injection of high-dose intravenous insulin that was associated with insulin sensitivity in the thoracic and hepatic muscles, 3PUFA and ALA acid has been shown to improve the sensitivity of insulin in the muscles with increased activation and production of other protein species caused by the gene expression and during translating process for mRNA and including 70KDa-ribosomal protein, S6 kinase and thus help to stimulate growth and activity within the muscles. The correct nutritional basis with provision of the appropriate factors and fatty acids, which are combined with the promotion of specific hormonal and genes expressions represented by insulin, is another base for health and economic improvement by all standards (Tesseraud *et al*., 2013).

Hormone Insulin

Insulin hormone is one type of polypeptide hormones with a protein nature. It consists of a group of amino acids (51 amino acids) distributed on two chains with di-sulfur bridges. The first series, called A, contains 21 amino acids,

while the other series B, contain 30 Amino acid, as the molecular weight of insulin hormone (5802) Dalton and it is characterized by the presence of electric drop point appear at (PH = 5.5), Fujita *et al*. (2018). It is usually observed that the B series is characterized by the presence of a type of central distillation inside it, which is characterized as being distributed on both chains during the initial stages of the formation of the hormone showing the extent of the correlation between them, which decays later and remains the anchor within the series B, Kono *et al*. (2005).

The pancreas is the primary and the only gland responsible for insulin production, it consist of three lobes in most Domestic birds except in ducks and goes, which consist of only two lobes Pancreas weights in chicken about 40gm while its weight in ducks and goes ranged between (80-100) gm, and each lobes connects with a channel to deliver the pancreatic juice to duodenum, it content Bicarbonates in order to adjust the acidity of intestine beside other digestive enzymes which located to digest all of proteins, fatty and carbohydrates like the amylase, trypsin and pancreatic lipase in addition to its secretion to Insulin and Glucagon hormones as they are very important to regulate level of blood sugar (Hazelwood *et al*.,1968). Insulin hormone has important effect on chicken as other vertebrae because it enters most of the metabolic processes in body like carbohydrate metabolism, the advantage of absorption and transfer of glucose, Glycogen pathways, control Enzyme in liver, transfer the amino acid and paths of protein syntheses. Jozefiak *et al*. (2010).

Mechanisms of Insulin Hormone Secretion and formation

The insulin hormone is produced and secreted by β cells in the Langerhans of the pancreas after the genetic translation of insulin gene where the preproinsulin was formed and consisting of a single peptide series that turns into proinsulin by losing one peptide when enters the RER-The Rough Endoplasmic Reticulum, which in turn consists of A-series with amino-end and B-series which end by carboxylic end and both series are connecting by (Peptide-c). After the insulin entry, it was exposed to a number activity of the enzymes that transform it into the final mature form to be stored inside Golgi, which is considered to be rich environment in sulfur and zinc, which contribute to increase the structural support of each of the two chains of the hormone, as well as providing it with all the important information that enables hormone to move to a more stable position. The molecules of insulin in the liquid circles are in the form of binary compounds (Dimers) because of the formation of hydrogen bonds between the sulfur terminals of the series A and B, where the binary compounds are characterized by rapid spread in the blood, unlike hexagon compounds which need for longer periods of spread due to the presence of zinc so it remain within the device. The secretion of insulin from its constituent cells in the Langerhans was characterized by a fluctuating nature which forms the pulsatile insulin, and in order to complete the process of secretion of natural insulin needs to create a kind of cellular balance and this is available by (K^+ -ATP) and (Ca^{2+}) pumps, which regulate the electrical voltage and re-polarize the cell by closing the exit gates of potassium and opening the gates of calcium entry and thus secrete insulin after the cell alert for the presence of abundance of glucose and need to be produced to balance the ion between the inside and outside of the cell, Wilcox, (2005) (Figure 2).

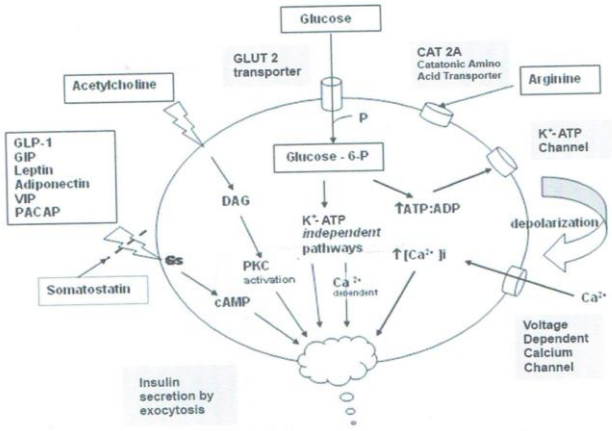


Fig. 2 : The process of secreting the insulin hormone from its constituent (Wilcox, 2005)

Insulin secretion has the lowest rates when blood glucose level ranges from 80-100 mg/ml and when an increase in its level exceeds the normal limit, Beta cells synthesize and secrete insulin noting that there are several factors that stimulate pancreatic cells to secrete insulin included (increasing amino and fatty acids in the blood or secretion of bowel hormones and acetylcholine or nervous stimulation of cells when food is seen). However, there are other factors inhibit the catalytic action of the secretion of insulin hormone represented by potassium deficiency in the body and somatosatine. Hence, there are two types of insulin secretion, either quick-response secretion when there is a direct increase in the level of blood glucose and thus disappear its impact as fast as it started or to be slow but under the influence of longer sustainability, and the biosynthesis and composition of insulin are subject to a set of controlled indicators included gene expression levels or mechanisms to be synthesized during translation and replication or manufacturing continuity within constituent cells until they are triggered by induction (Giorgino *et al*., 2005).

Pathways and signals of Insulin hormone within cells

When insulin reaches the cells, it usually start looking for its receptors, which embrace and associate to the insulin and distributing on the surfaces of most body cells and spread as many as possible on the cells of the fatty, muscular and hepatic tissues. Therefore, it is considered the link between the outer and inner medium of the cell, and these receptors consist of two main parts where the largest part is called alpha, which has a molecular weight of 130.000 Dalton and extends to the outside of the cell. While the smaller part of the receptors is called beta and has a molecular weight of 90,000 Dalton, as well as extends to the inside of the cells which end up with one of the enzymes that become active when the association of insulin with its receptor, which works to add a phosphor molecule to the inner part of the receptor autonomously, recording the initiation of a set of processes that show the physiological function of insulin and among the physiological processes that arise after the association of insulin with the receptor that consumes energy by converting the adenosine Triphosphate (ATP) molecule to adenosine Diphosphate (ADP). The phosphorus molecule is then connected to the inner end of the IRS-Insulin Receptor Substrate which then release the higher concentrated insulin signal (PI3k-Phosphatidylinositol 3-kinase). This type of

indicator contributes to the formation of a group of internal protein species (AKT / PKB-protein kinase B) and PIPD1 & 2 (PKC-Protein kinase C). These combined types directly influence the ability of glucose-containing mechanisms to activate and stimulate a number of glucose-important transport (GLUT4-Glucose Transport protein2) Simon et al (1986), Seki et al (2003) as well as the indirect effects of regulating the formation of the pathways (glycogen synthesis, protein synthesis, Anti-lipolysis and gene expression) under the influence of the active gene factors MAP Kinase-Mitogen activated protein kinase and Mitogenic effects in Nucleus within the nucleus as shown in Figure (3) Wilcox,(2005)

Allowing the process of glucose transferring into the cell is one of the results of the effect of hormone binding with the receptor and here begins the stage of enhancing the entry of glucose to the inner medium of the cell by activating the roles of a number of specialized vectors, and since the cell wall is naturally consisting of three layer (two layers of fatty internal and external mediated protein layer) and due to its distinctive character as an elective influence, substances that are unable to influence through it and dissolve in fatty molecules, including glucose, need to be equipped with vectors, Thorens and Joost (2001). Some of them need energy and others work according to the simple propagation system from the areas of high concentration to the areas of low concentration. On this basis, these transporters have been divided into two main types: GLUT-Glucose Transporter, which do not need to provide energy units to complete their transfer. They are also divided into multiple types depending on the location of the cells including:

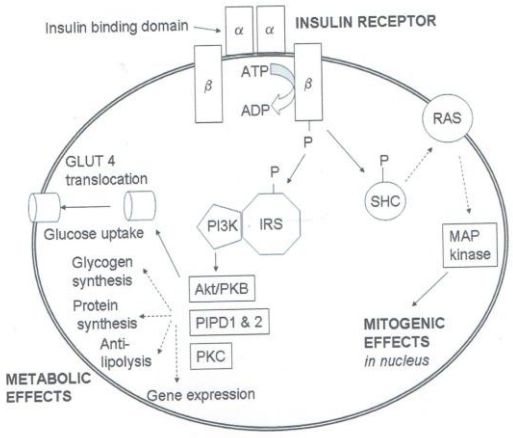


Fig. 3: Insulin receptor and pathway inside the cell (Wilcox, 2005).

GLUT-1: This transporter is present in all tissues of the body. It transfers the basic requirement of glucose, which forms an important part of the cerebral blood barrier system to ensure that the glucose reaches the brain well and adequately.

(GLUT-2): It works only when there is an abundance of glucose in high level, and this kind is the transporter of glucose inside the beta cells to work under the high glucose on the secretion of more insulin. Thus, it is precisely this characteristic that provides protection against the untreated insulin secretion of the pancreas.

GLUT-3: It is present in all tissues and is the primary transporter within tissues.

GLUT-4: This transporter is found in the muscle and adipose tissue and located inside the cells and are directed to the surface of the cell as one of the adjuvants of insulin incubation by its receptors, Seki, et al (2003).

GLUT-5: This transporter is found in the cells of the digestive tract, liver and sperm as well as transfers fructose sugar, which provides a large part of the energy.

GLUT-6 and GLUT-7: Each of these transporters contributes the inclusion of phosphorus-related glucose in carbon atom 6 into the cell during insulin excretion in combination with the GLUT-2 receptor, and they are found in the liver and other tissues, Kono *et al*. (2005).

While the second type of transporter, which needs energy as it transfers glucose and sodium and called (SGLT-Sodium Glucose Transporter), and exists in the digestive system and kidney and includes (SGLT-1) which existing in the intestines and renal tubules and (SGLT-2) that found in the renal tubules Shisheva,(2008).

These complex pathways and their various stages start from the point of insulin binding to its receptors and ending with the emergence of phylogenetic effects may accompanied by some genetic defects that lead to decreased efficiency of hormone secretion and forming what is known as the phenomenon of (descending regulation of insulin) which means that the number of insulin receptors decreases because of the high level of secretion and insulin abundance and cumulative regulation of insulin that known as the phenomenon of insulin regulation which resulted from the increase in the number of insulin receptors due to the lack of available insulin. It was also found that any increase in the levels of cortisone secretion contributes to the inhibition and decrease the correlation between insulin and it is receptors (Smith, 2002; Reaven, 2004).

The vital functions of the insulin hormone in poultry

The insulin hormone stimulates hepatic and muscle cells as well as fatty tissues to utilize the glucose as a source of energy production. Therefore, the stored fats in the body tissues are not allowed to metabolize and form energy through its inhibitory action to secrete glucagon hormone from alpha cells within the pancreas gland in normal cases of cell metabolism. It also contributes to the glucose storage processes in the form of glycogen in liver and muscles cells until they are used again when needed or a lack of insulin level in the blood, Simon (1989). The lower levels of the hormone in the body and the presence of high blood sugar (glucose) in this case the body will not be able to achieve the actual benefit of available high energy. There were additional functions performed by the insulin hormone included:

1. Helps fatty cells to use fatty acids and store them until they utilize.
2. Enable cells to use amino acids and protein synthesis.
3. Reduce the level of protein degradation.
4. Reduces ketones in the liver.
5. Contributes to reduce the processes of cracking stored fat and secretion in the blood and helps the cells to use potassium.
6. Reduces glucose synthesis indirectly from non-sugary compounds. The primary function of insulin is to help

store carbohydrates, proteins and fats and prevent cracking (Cefalu, 2001).

New studies for INSg on commercials Broiler Ross to be used in selection programs

Lei *et al*. (2007) and LI *et al.* (2008), mentioned that using molecular marker or genetic marker on blood or tissue it's a good tool could be used in selection programes to reduced rearing period and breeding costs with benefits for farmers and according to the consumer desire, and could be used in animal breeding too. (AL-samarai and AL-kazaz, 2015). So Muhmad (2016) found on study on broiler Ross308 in Iraq by using PCR –RFLP taqnic with MSPI restriction enzyme to determine the polymorphisms of INSg in fragment T3737C in insulin gene which was with 372 bp according to Kaho *et al*. (2012). To determine the association of this fragment with economic and productive traits in order to use this study in aerial selection programs according to the good genotype and its relationship with body weight, body length, breast width, breast weight and other economic traits. Two genotypes where found the first was with size of 372 bp the TT the dominant and 372,234,138 for the second genotype with TC as hetero one. AL-Anbari &Mohamed (2017) mentioned that there where a significant effect P<0.05 for male on carcass weight, breast weight leg and wing weight traits compared with female in the same genotype, and they found that male with TT genotype effect significantly P< 0.05 on live body weight traits for the seam studded fragment Figure 4.

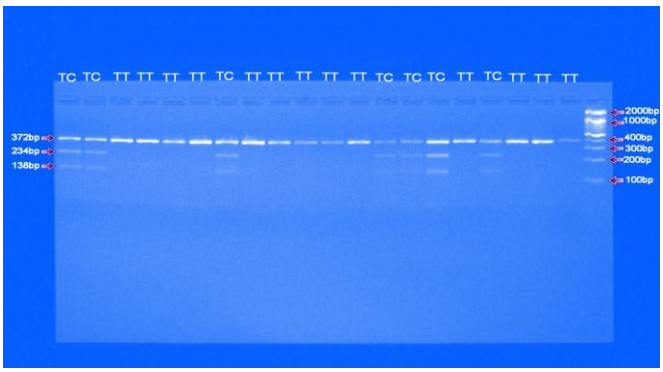


Fig. 4 : The genotypes of INSg in fragment C 3737T

Rasheed (2018) on her study on introne 2 (C1549T) and untranslated region (3..UTR)(A3971G3) of INSg on broiler Ross 308 to be used in aerial selection programs too, and by using PCR-RFLP and MSPI restriction enzyme found that the first fragment which was with 529 bp was with three genotype the CC the wild CT the hetro and TT the mutant, the second fragment with 281 bp., was with GG the wild, the GA the hetro and AA the mutant . Figure 5 & 6.

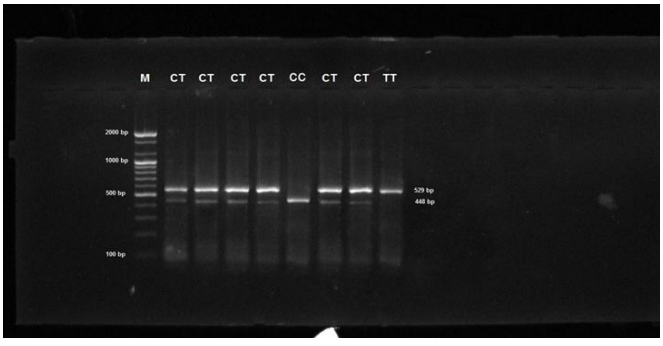


Fig. 5 : Polymorphisms of (C1549T) INSg.

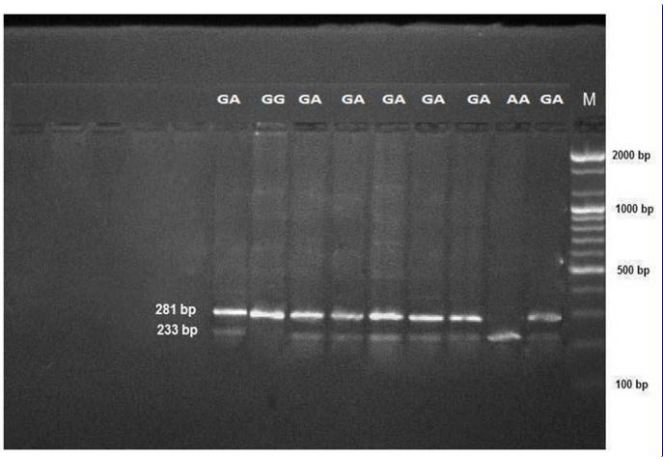


Fig. 6 : Polymorphisms for (A3971G) of INSg fragment.

Rasheed & AL-Anbari (2018)mentioned that there was no significant effect P<0.05 for these polymorphisms of both fragment on studied traits except between sexes for dressing %, carcass weight, live body weight and relative cuts weights and was with highly significant for breast weight for male than female.

References

1. AL-Anbari, E.H. and Mohamed, H.J. (2017). Determination of Insulin gene hormone INSg polymorphisms and their relationship with some productive traits in both sexes of hybrid broiler Ross308. The Iraqi Journal of Agricultural Sciences, (6)48: 1381-1388.
2. AL-samarai, F.R. and AL-kazaz, A.A. (2015). Application. Molecular markers in animal breeding: Review. American Journal of Applied Scientific Research, 1(1): 1-5.
3. Burt, D.W. (2005). Chicken genome. 15: 1692-1698.
4. Bennett, A.U.; Sovio, A.; Ruokonen, H.; Martikainen, A.; Pouta, S.; Taponen, A.L.; Hartikainen, S.; Franks, L.; Peltonen, P.; Elliott, M.R. and McCarthy, M.I. (2005). Noaossociation between insulin gene variation and adult metabolic phenotypesin a large Finnish birth cohort. Diabetes. 48: 886-891.
5. Bazaes, R.A.; Petry, C.J.; Ong, K.K.; Oevila, A.; Dunger, D.B. and Mericq, M.V. (2003). Insulin gene VNTR genotype is associated with insulin sensitivity and secretion in infancy. Clin. Endocrinol. 59: 599–603.
6. Beuzen, N.D.; Stear, M.J. and Chang, K.C. (2000). Molecular markers and their use in animal breeding. Vet. J., 160: 42-52.
7. Chunxia, L.U.; Lam, N.H. and Menon, R.K. (2005). New muers of the insulin family: regulators of metabolism, growth and now reproduction. Pediatric Res., 57: 1-4.
8. Cefalu, W.T. (2001). Insulin resistance: cellular and clinicalconcepts. Exp Biol Med. 226:13-26.
9. Dupont, J.; Tesseraud, S. and Simon, J. (2009). Insulin signaling in chicken liver and muscle. Endocrinology. 163: 52-57.
10. Dupont, J.; Derouet, M.; Simon, J. and Taouis, M. (1999). Corticosterone alters insulin signaling in chicken muscle and liver at different steps. J. Endocrinal. 162: 67-76.
11. Fujita, S.; Yamaguchi, M.; Hiramoto, D.; Saneyasu, T.; Honda, K. and Kamisoyama, H. (2018). Effects of fasting and refeeding on m RNA levels of Insulin –Like

Growth Factor- binding proteins in chicken liver and brain The Journal of Poultry Science,0180005.

12. Giorgino, F.; Laviola, L. and Eriksson, J.W. (2005). Regional differences of insulin action in adipose tissue: insights from in vivo and in vitro studies. Acta Physiol Scand., 183: 13-30.
13. Hazelwood, R.L.; Kimmel, J.R. and Pollock, H.G. (1968). Biological characterization of chicken insulin activity in rats and domestic fowl. Endocrinology. 83: 1331-1336.
14. Joost, H.G. and Thorens, B. (2001). The extended GLUT- family of sugar/polyol transport facilitators: nomenclature, sequence characteristics, and potential function of its novel (review). Mol. Member. Biol., 18: 247-256.
15. Kaho, D.V.A.; Khang, N.T.K.; Ngu, N.T.; Matey, J.; Loan, H.T.P. and Thuy, N.T.D. (2012). Single nucleotide polymorphisms in Gh, Ghr, Ghsr and Insulin candidate genes in chicken breeds of Vietnam. Green Journal of Agricultural Science. 10: 716-724.
16. Kono, T.; Nishida, M.; Nishiki, Y.; Seki, Y.; Sato, K. and Akiba, Y. (2005). Characterization of glucose transporter (GLUT) gene expression in broiler chickens. Br. Poult. Sci., 46: 510-515.
17. Kadlec, J.; Hosnedlova, B.; Rehout, V.; Citek, J.; Vecerek, L. and Hanusova, L. (2011). Insulin-Like growth factor-1 gene polymorphism and its association with growth and slaughter characteristics in broiler chickens. J Agrobiol. 28(2): 157-163.
18. Lei, M.; Luo, C.; Peng, X.; Fang, M.; Nie, Q.; Zhang, D.; Yang, G. and Zhang, X. (2007). Polymorphism of growth –correlated genes associated with fatness and muscle fiber traits in Chickens. Poult Sci., 86: 835-842.
19. Li, H.; Zhu, W.; Chen, K.; Wu, X.; Tang, Q. and Gao, (2008). Associations between GHR and IGF-1 gene polymorphisms and reproductive traits in Wenchang Chickens. Turk. J. Vet. Anim. Sci., 32: 281-285.
20. Mohamed, H.J. (2016). Studying of Insulin gene polymorphisms and its relationship with some productive traits in Broiler (Ross308). M.Sc. Baghdad Uni. Agricultural Engineering Sciences.
21. Qui, F.F.; Nie, Q.H.; Luo, C.L.; Zhang, D.X.; Lin, S.M. and Zhang, X.Q. (2006). Association of single nucleotide polymorphisms Of the insulin gene with chicken early growth and fat deposition. Poultry science, 85: 1-6.
22. Rasheed, S.U. and AL-Anbari, E.H. (2018). The polymorphisms of insulin gene hormone in fragments (C1549T) and (G3971A) in hybrid chicken Ross 308. Journal of Research in Ecology. 6(2): 2016-2023.
23. Rasheed, S.U. (2018). Polymorphisms of intron2 (C1549T) and untranslated region (3...UTR) (A3971G3) of insulin hormone gene and its association with some productive traits in broiler (Ross308). M.Sc. Baghdad Uni. Col. Agricultural Engineering Sciences.
24. Reaven, G. (2004). The metabolic syndrome or the insulin resistance syndrome, Different names, different concepts and different goals. Endocrinal Metab Clin North Am, 33: 283-203.
25. Souza, A.M. (2004). Insulin or insulin- like studies on unicellular organisms. Brazilian archives of biology and technology. 47: 973-981.
26. Stead, J.D.H.; Hurles, M.E. and Jeffreys, A.J. (2003). Global haplotype diversity in the human insulin gene region. Genome Res., 13: 2101-2111.
27. Shiseva, A. (2008). Phosphoinositides in insulin action on GLUT4 dynamics: not just Ptdins (3, 4, 5). Am. J. Physiol. Endocrinol. Metab, 295: 536-544.
28. Smith, U. (2002). Impaired diabetic insulin signaling induction occur in fat cells long before glucose intolerance-is insulin resistance initiated in the adipose tissue. Relat Metab Disord., 26:897-904.Tomson, G., Robinson, W.P., Kuhner, M.K., Joe, S. and Klitz, W. 1989. HLA and insulin gene associations with IDDM. Epidemiol., 6: 155-160.
29. Simon, J. (1989). Chicken as a useful species for the comprehension of insulin action. Crit. Rev. Poult. Biol., 2: 121-148.
30. Seki, Y.; Sato, K.; Kono, T.; Abe. H. and Akiba, Y. (2003). Broiler chickens (Ross strain) lack insulin-responsive glucose transporter GLUT4 and have GLUT8 c DNA. Gen. Comp. Endocrinol. 133: 80-87.
31. Tesseraud, S.; Chartin, P.; Metayer, S.C.; Hermmer, D.; Simon, N.; Peyronnet, C.; Lessire, M. and Baeza, E. (2013). Modulation of the insulin anabolic signaling cascade in growing chickens by n-3PUFA. British journal of nutrition. 111:761-772.
32. Wilcox, G. (2005). Insulin and Insulin resistance. Clin. Biochem. Rev., 26: 19-39.
33. Wong, G.K.S.; Liu, B.; Wang, J.; Zang, Y.; Yang, X. and Zhang, Z.J. (2004). A genetic variation map for chicken with 2.8 million single nucleotide polymorphisms. Nature. 432: 717-722.
34. Watson, J.D.; Hopkins, N.H. and Roberts, J.W. (1987). Molecular biology of gene.4th Ed. The Benjamin / Cummings publishing company. Inc. USA.
35. Zhao, W.Q.; Chen, H.; Quon, M.J. and Alkon, D.L. (2004). Insulin and receptor in experimental models of learning and memory. European journal of pharmacology., 490: 71-81.