EVALUATION OF THE EFFECTS OF AMINO ACID SUBSTITUTION ON THE FUNCTION OF HEAT SHOCK PROTEIN 70 OF CHICKEN USING IN SILICO APPROACH

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ABSTRACT
The main objective of the study was to determine the effect of genetic variation resulting in amino acid substitution on the function of heat shock protein 70 of Chicken. Data on heat shock protein (HSP) 70 was retrieved from the database of National Centre for Biotechnology Information (NCBI). The 3D structure of HSP 70 was predicted using Phyre 2 server. Effect of amino acid substitution on the function of HSP was predicted using PANTHER server. MutPred 2 server was used to predict the mechanism of structural changes on HSP 70. The results indicated that all the amino acid substitutions evaluated had adverse effects and resulted in changes in the molecular structure of heat shock protein 70 of Chickens. It can be concluded that Single Nucleotide Polymorphism is a useful biomarker for evaluating the functions of heat shock protein 70 of Chickens.
Key words : Genetic variation, Heat shock protein, Functional effects, Insilico

INTRODUCTION

Intensive poultry production system is associated with stressful conditions that may compromise the welfare of birds (Krishnan *et al*., 2023). Cellular stress response occur to maintain homeostasis, this response is characterized by the production of heat shock protein 70 which modify the response to stress Kregel, 2002). Heat shock protein play a critical role in resistance to physical and chemical stresses. HSP gene expression is activated in response to stress, it plays a protective role and ensure cell survival during stress. Single Nucleotide Polymorphism in heat shock protein 70 of Chickens have been documented (Tamzil *et al*., 2013). Variations in expression of heat shock protein 70 associated with variable meat quality have been reported (Di luca et al., 2011). Effects of heat stress in chicken include reduction in egg production, egg weight and body weight gain (Kennedy et al., 2022). Thermo tolerance in chicken have been associated with genetic variation in heat shock protein 70. High correlation between HSP 70 expression and meat quality has been reported (Xing *et al* ., 2017). Heat stress resulting from climate change adverse affect poultry production and disease resistance. Studies on impact of genetic variation on heat shock protein will contribute to identification of genetic markers for heat tolerance. Such information can be used in breeding programmes to produce heat tolerant Chickens.

MATERIALS AND METHODS

Data on heat shock protein 70 of Chicken was retrieved from the database of National Centre for Biotechnology Information for computational analysis. The 3D structure of heat shock protein 70 was predicted using Phyre 2 server (Kelly, 2015). Phyre 2 uses advanced remote homology detection methods to build 3D models, predict ligand binding sites and analyse effects of amino acid variants. The effects of amino acid substitution on heat shock protein 70 was evaluated using Protein Analysis Through Evolutionary Relationships (panther server) as described by Tang and Thomas, 2016. Effects of amino acid substitution on the molecular structure of heat shock protein 70 was predicted using MutPred 2 server (Pejaver, 2020).

RESULTS AND DISCUSSION

Table 1: Predicting effects of genetic Variation on Heat Shock Protein 70 of Chicken using PANTHER SERVER

Amino acid Substitution	Preservation time(Million years)	Functional effects
R 250 G	**1629**	**Damaging**
I 256 N	**1368**	**Damaging**
K 274 R	**1629**	**Damaging**

R- Arginine, G- Glycine, I- Isoleucine, N- Asparagine

The 3D structure of heat shock protein 70 of Chicken is shown in Figure 1.

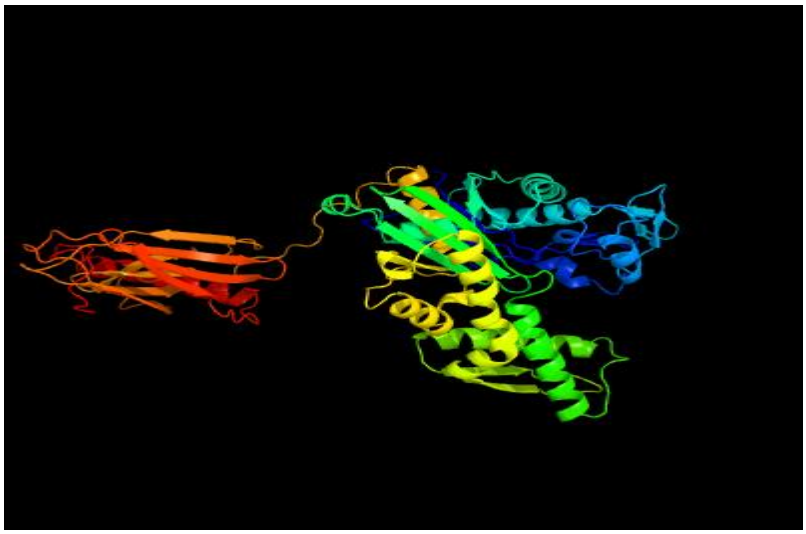

Figure 1: 3D structure heat shock protein 70 of Chicken

Table : 2 Predicting structural effects of genetic variation on heat shock protein 70 of Chicken using MUTPRED 2 SERVER

Substitution	Mutpred 2 Score	Molecular mechanism of structural change	Probability
R 250 G	0.758	Altered coiled coil	0.64
		Altered disordered interface	0.47
		Gain of acetylation at K251	0.29
		Altered DNA binding	0.26
		Gain of methylation at K253	0.14
		Altered stability	0.11
I256N	0.760	Gain of intrinsic disorder	0.46
		Altered disordered interface	0.40
		Altered DNA binding	0.32
		Loss of acetylation at K 260	0.28
		Gain of B- factor	0.25
		Loss of methylation at K 274	0.11
K 274 R	0.624	Altered coiled coil	0.33
		Gain of intrinsic factor	0.30
		Altered disordered interface	0.27
		Loss of methylation at K 274	0.14
		Altered metal binding	0.10

The results indicated that substitutions of arginine by glycine at position 250, isoleucine by asparagine at position 256 and lycine by arginine at position 274 respectively resulting in damaging effects on the function of heat shock protein 70 of Chicken. The amino acid substitutions evaluated

resulted in changes in the structure of heat shock protein 70. The most significant changes in molecular structure are altered coil , altered disordered interface and gain of intrinsic disorder. It can be concluded that Single Nucleotide Polymorphism are useful genetic markers for evaluating the functions of heat shock protein 70 in Chickens. Based on the results of this study, association studies of single nucleotide polymorphism and functions of heat shock protein 70 is recommended.

CONCLUSION

The results of this study indicated all the evaluated amino acid substitutions have adverse effect on the functions of heat shock protein 70. Genetic variations in HSP 70 may provide significant biomarkers of adaptation to heat stress in chickens. These information are useful inbreeding programs aimed at producing thermo tolerant chickens.

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