Expression of IGF-1R, SIRT1, and LEPTIN in the therapeutic effect of *Cynodon.dactylon* in Letrozole induced PCOS rats

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**ABSTRACT**

Polycystic ovarian syndrome is a female reproductive disorder with a prevalence rate of 2.2% to 26% in the world and Indian adolescents at a rate of 9.13%. It is a heterogeneous endocrine syndrome related to increase in the secretion of hyperandrogenemia with increasing risk of hyperinsulinism, type 2 diabetes mellitus, Hirsutism dyslipidemia, cardiovascular diseases and finally leading to an endometrial tumor. *Cynodon dactylon* or Bermuda grass is seen all over the world. *C. dactylon* is a stoloniferous, hardy perennial grass, very much variable with long rapid growing, rooting at nodes, forming a dense tuft on the top of the soil. *C. dactylon* plant was collected and 100gm of plant powder was mixed with 1,000ml of distilled water and heated till boiling temperature. The mixture was filtered and lyophilized. All the animals were induced for PCOS by giving Letrozole with an oral feeding needle for 21 days and the vaginal smear was examined to confirm PCOS. From 22-42 days, the animals were treated with the drug and Metformin. The animals were divided with four groups as Control, Induced group, treatment group with 500 mg/kg (*Cynodon dactylon*), and Referral group 100mg/kg (Metformin). After 24hr of the last dose, the animals were sacrificed. Blood and tissue were collected for analysis. IGF-1R, LEPTIN is a gene which mainly acts on the hypothalamus in regulating the gonadotropin release hormone and gonadotropin secretion it regulates the energy level and adipose tissue storage in the body. SIRT1 is a nicotinamide adenosine dinucleotide which increases the insulin sensitivity and decreases insulin resistance by modifying the insulin signal transduction pathway.

**INTRODUCTION**

The polycystic ovarian syndrome is a female reproductive disorder with a prevalence rate of 2.2% to 26% in the world and Indian adolescents at a rate of 9.13% (Nidhi et al., 2011). A regular menstrual cycle is defined as characterized by an inter-menstrual interval of not that less than 21 and not more than 35 days with no more than four-day variation from cycle to cycle (Franks, 1989). The polycystic ovarian syndrome is a heterogeneous endocrine syndrome related to increase in the secretion of hyperandrogenemia with an increasing risk of hyperinsulinism, type 2 diabetes mellitus, Hirsutism dyslipid-
C. dactylon plant was collected from the campus of Sri Lakshmi Narayana Institute of Medical Sciences Puducherry. The 100gm of plant powder was mixed with 1,000ml of distilled water and heated till boiling temperature. The mixture was filtered and lyophilized.

All the animals were induced for PCOS by giving Letrozole with oral gavage for 21 days and the vaginal smear was examined to confirm PCOS. From 22-42 days, the animals were treated with the drug and Metformin. The animals were divided with four groups as Control, Induced group, treatment group with 500 mg/kg (Cynodon dactylon), and Referral group 100mg/kg (Metformin).

After 24 hrs of the last dose of the drug and metformin, the animals were anesthetized with overdose as per the standard animal experimental procedure. The blood was collected in a vacutainer tube by direct heart puncture. The serum tube was allowed to clot and centrifuged at 3000rpm for 15 minutes and serum was separated and kept stored at-20 degree. The ovarian tissue was dissected and removed from the animals for analysis of gene expression.

Determination of enzymatic antioxidants

Lipid peroxidation activity was determined by following the method of R. M. A. Hammouda, (Rahman, M.A. Hammouda and M.M. Khalil, 1995). The superoxide dismutase activity was determined by using Van Rossun (Rossum and Plas, 1997). Catalase activity is done by the method outlined by Luck (Luck, 1965). (RNA isolation and quantitative RT-PCR) Total RNA was extracted from cells using TRIzol reagent (Invitrogen) according to the manufacturer’s protocol.

Gene expression

Reverse transcription was performed using Prime Script™ 1st strand DNA Synthesis Kit (TAKARA BIO INC) following the manufacturer’s instructions.

Primers used

IGF-1R FP: 5’TCTAAGGCCAGAGGTGGAGAATA 3’
IGF-1R RP: 5’TACCAGCTGCCTCGAGCAGC 3’
Leptin FP: 5’GACATTTCACACAGCCACTGTC 3’
Leptin RP: 5’GAGGAGGTCTCGCGAGGTT 3’
SIRT1 FP: 5’GACATTTCACACAGCCACTGTC 3’
SIRT1 RP: 5’TGGTTCATTATCATAGGTGGCC 3’

Statistical analysis

Statistical differences between Control, Induced, Treatment and Referral groups were applied using Graph Pad Prism software version 8 (Graph Pad
Figure 1: Expression of IG-1R of Control, Induced, Treatment, and Referral group. The Treatment group shows a significant change over the induced and Referral group.

Figure 2: Expression of LEPTIN in Control, Induced, Treatment, and Referral group. The Referral group shows a significant change over the induced and Treatment group.

Figure 3: Expression of SIRT in Control, Induced, Treatment, and Referral group. The Treatment group shows a significant change over the induced and Referral group.

The results were expressed as mean ± SEM. Results were analyzed using one-way ANOVA, and data were considered to be statistically significant at P <0.05.

RESULTS AND DISCUSSION

Lipidperoxidase Significant changes are observed in control and induced group*P<0.05 and comparing with treatment group*P<0.05. Superoxide Table 1.

Dismutase

There was a decrease in the values of the induced and control group and an increase in the value of the treatment group and it was significant.

Catalase

we are not able to observe any changes in the catalase activity.

Expression of IGF-1R, Leptin & SIRT1

The expression of IGF-1R has increased in the Induced group compared to Control, and the expression of IGF-1R has tremendously decreased in Treatment (P<0.05) of ovarian theca cells and to the level of control in Referral Figure 1.

Leptin expression was decreased in the Induced group of ovarian theca cells compared to Control, and the expression Leptin has significantly increased in Treatment and the level of control and Referral it was similar Figure 2.

The expression of SIRT1 has decreased in the Induced group compared to Control, and the expression of SIRT1 has increased in Treatment (P<0.05) of ovarian theca cells and Referral Figure 3.

The ovarian cycle is controlled by the hypothalamus – anterior lobe of the pituitary-gonadal axis. This leads to the development of the Graafian follicles (Lopez-Diaz and Bosu, 1992). Letrozole is an aromatase inhibitor which disturbers the normal estrus cycle in the female rats to develop a well-defined PCOS. At present metformin is used for the treatment of PCOS, nevertheless with the side effects on long term systems (Karateke et al., 2018). The study has already shown C.dactylon can improve the reproductive activity in normal animals (Nayanatara, 2012). The antioxidant effect of C.dactylon has been proved by phytochemical analysis (Pawaskar and Sasangan, 2017). In our observation, significant changes were seen in the gene regulating estrus cycle in between control and induced group and induced and treatment group. IGF-1R. LEPTIN is a gene which mainly acts on the hypothalamus in regulating the gonadotropin release hormone and gonadotropin secretion it regulates the energy level and adipose tissue storage in the body. Expression of this gene may act on mature Graafian follicles and activate 17-α hydroxylase enzyme, which regulates the ovarian cycle (Mani et al., 2011; Rizk and Sharif, 2015; Correia et al., 2017). In our study, we observe IGF-1R is expressed ten folds in the Induced group and it was found to be decreased to 2 folds in Treatment group P<0.05. Identical expression was seen in Control and Referral group. Leptin expression
Table 1: The Lipid peroxidase test, Superoxide Dismutase, of Control, Induced, Treatment, and Referral group.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Induced</th>
<th>Treatment</th>
<th>Referral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipid peroxidase (MDA) nm/ml</td>
<td>16.03 ±5.88</td>
<td>50.64 ±6.75#</td>
<td>32.05 ±4.84*</td>
<td>37.18 ±5.84</td>
</tr>
<tr>
<td>Superoxide Dismutase U/ mg protein</td>
<td>52.18 ±0.345</td>
<td>46.6 ±0.145#</td>
<td>47.55 ±0.125*</td>
<td>50.88 ±0.115</td>
</tr>
<tr>
<td>Catalase μmol / mg protein</td>
<td>0.05 ±0.003</td>
<td>0.03 ±0.004</td>
<td>0.05 ±0.003</td>
<td>0.04 ±0.004</td>
</tr>
</tbody>
</table>

was found to be half fold in the induced group and six folds in Treatment group P<0.05. In the Referral group, it was three folds and in Control, it is two folds. This is mainly due to the antilipidemic activity of C.dactylon (Kaup et al., 2011). SIRT1 is a nicotinamide adenine dinucleotide which increases the insulin sensitivity and decreases insulin resistance by modifying the insulin signal transduction pathway. Decreasing in the SIRT1 expression leads to insulin-related disorders (Tao et al., 2015). SIRT1 expression was found 0.5 in the Induced group and three and a half fold in Treatment P<0.05 and Referral group was two folds and it was lesser in Control as single folds. This is mainly due to the antidiabetic activity of C.dactylon (Karthik and Kumar, 2011).

CONCLUSIONS

Our study is the first study to conclude that Cynodon dactylon can treat polycystic ovarian syndrome. The Expression of LEPTIN, IGF-1R, SIRT1 gene shows clearly, the reversal of the animal to normal condition is mainly due to the antihyperlipidemic and antidiabetic activity of the plant.

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