

## VANADIUM SUPPLEMENTATION REDUCES HIGH FAT DIET INDUCED HYPERLIPIDEMIA, HYPER INSULINEMIA & HYPERGLYCEMIA IN RABBITS

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**ABSTRACT:** Vanadium is considered as an essential trace element in some animals. In human's classification of vanadium as an essential nutrient is still a topic of debate among various research groups. Nutritionally vanadium is thought to be a cofactor in various enzymatic reactions. Increased levels of insulin in blood (hyperinsulinemia) associated with type-2 diabetes mellitus. Increase intake of fat induces hyperinsulinemia which may leads development of type-2 diabetes mellitus. The present study aimed to know the effect of vanadium supplementation on high fat diet induced hyperlipidemia, hyperinsulinemia and hyperglycemia. In this study New Zealand white breed male rabbits divided into three groups. Group-I: rabbits fed with standard diet Group-II: fed with group-I diet and egg yolk, Group-III: rabbits fed with group-II diet and supplemented with 0.5mg/kg of elemental vanadium as sodium meta vanadate. Total cholesterol, LDL-cholesterol and Triglycerides were significantly decreased in G-III when compared to G-II after the experiment. HDL-cholesterol levels are similar in G-II & G-III. Plasma glucose and insulin levels were significantly decreases in G-III than G-II. The present study shows the antidiabetic and antilipidemic role of vanadium in the experimental rabbits. Supplementation of vanadium may prevents hyperglycemia and cardiovascular risk factors like, insulin resistance and hyperlipidemia in diabetes mellitus

**Key words:** Sodium Meta Vanadate, hyperglycemia, hyperlipidemia, antidiabetic

### INTRODUCRION

Diabetes mellitus is a common endocrine disease characterized by hyperglycemia and long-term complications affecting the eyes, kidneys, nerves, and blood vessels (Kim YM,et al 2007&. Tuttle KR, et al 2007). At present, there are more than 194 million people with diabetes worldwide (Liao Z,Chen X 2010), and this number is estimated to increase to 333 million by 2025 (Zhu CF et al 2010), The relationship between cholesterol and atherosclerosis has been known for a long time. It is also well known that diabetes and metabolic syndrome are often accompanied by hyperlipidemia and related to atherosclerosis (Toru Kita, H,2001). Increased levels of insulin in blood (hyperinsulinemia) associated with type-2 diabetes mellitus. Increase intake of fat induces hyperglycemia and hyper insulinemia (Shinji Ikemoto, et al 1996) which may leads to the development of type-2 diabetes mellitus (Luc Djouss'E,et al.,2009).These defects in glucose metabolism are associated with a high atherogenic risk profile, and recent evidence suggests that they may play a role in the development of hypertension, dyslipidemia, and atherosclerosis(Reaven GM.,1991)&(DeFronzo RA.1992). Vanadium is considered as an essential trace element in some animals and in human's classification of vanadium as an essential nutrient is still a topic of debate among various research group (Sakurai H, Katoh et a 2006). Some consider vanadium to be an ultra trace element requiring dietary intake of only 20mcg per day. (Barceloux DG.1999). Nutritionally vanadium is thought to be a cofactor in various enzymatic reactions. Various experimental studies shows that vanadium favors insulin sensitivity (Lucy Marzban et al,2003) but none of the study available on sodium meta vanadate effects on high fat diet induced hyperlipidemia along with hyperinsulinemia. The present study aimed to know the effect of vanadium supplementation on high fat diet induced hyperlipidemia, hyperinsulinemia and hyperglycemia.

## MATERIALS AND METHODS

In the present study 18 New Zealand white breed male rabbits, weighing 1.8kg  $\pm$ 0.1 were used. Blood Samples (pre experimental) were collected before starting the experiment later the rabbits were divided into following groups.

Group-I: 6 rabbits were fed with standard diet (rabbit diet) procured from National Institute of Nutrition (NIN) Hyderabad, India.

Group-II: 6 fed with group-I diet and egg yolk containing 150 mg of dietary cholesterol.

Group-III: 6 rabbits fed with group-II diet and supplemented with 0.5mg/kg of elemental vanadium as sodium meta vanadate

These rabbits were fed for six months and blood samples (post experimental) were collected. Pre and post experimental samples were used for analyzing plasma Glucose, serum creatinine, serum Alanine transaminase (ALT) and serum Aspartate transaminase (AST). Total cholesterol, HDL-Cholesterol, LDL-Cholesterol, Triglycerides carried out by Chemistry analyzer by using commercial kits(HUMAN GmbH Germany) serum Insulin was measured after experiment by Chemilunoucence immuno assay method. (Beckman USA).

## STATISTICAL ANALYSIS

All the values of variables expressed in mean and standard deviation (Mean $\pm$ SD) using SPSS software.

## RESULTS

**Table-1 Body weight and serum Creatinine and Liver enzymes in rabbits before and after experiments.**

Rabbits	Weight(gms)		Serum Creatinine(mg/dl)		Serum ALT (IU/L)		Serum AST (IU/L)	
	Before	After	Before	After	Before	After	Before	After
Group-I	1.75	1.96	1.1 $\pm$ 0.12	1.2 $\pm$ 0.1	37 $\pm$ 8	42 $\pm$ 9.9	43 $\pm$ 11	49 $\pm$ 8.2
Group II	1.80	2.35	1.1 $\pm$ 0.11	1.2 $\pm$ 0.1	35 $\pm$ 9.5	49 $\pm$ 8.5	41 $\pm$ 12	52 $\pm$ 9
Group-III	1.79	2.0	1.2 $\pm$ 0.13	1.2 $\pm$ 0.11	38 $\pm$ 11	45 $\pm$ 7.5	46 $\pm$ 9.5	49 $\pm$ 8.5

ALT-Alanine transaminase AST-Aspartate transaminase Values are expressed in mean and standard deviation (Mean $\pm$ SD)

**Table-2 Plasma Lipids levels in rabbits before and after experiments**

Rabbits	Total cholesterol (mg/dl)		HDL-Cholesterol (mg/dl)		LDL-Cholesterol (mg/dl)		Triglycerides(mg/dl)	
	Before	After	Before	After	Before	After	Before	After
Group-I	29 $\pm$ 6.2	34 $\pm$ 8.0	10.5 $\pm$ 3.5	12 $\pm$ 4.6	16.8 $\pm$ 2.3	18 $\pm$ 7	27.5 $\pm$ 6.3	35 $\pm$ 6.5
Group II	38 $\pm$ 8.6	142 $\pm$ 32	13 $\pm$ 4.1	21 $\pm$ 3.2	18 $\pm$ 3.1	94 $\pm$ 12	37 $\pm$ 5.9	208 $\pm$ 18
Group-III	41 $\pm$ 6.0	104 $\pm$ 14	16 $\pm$ 3.9	19.5 $\pm$ 8.0	21 $\pm$ 3.4	68 $\pm$ 7.0	29 $\pm$ 5.9	168 $\pm$ 11

HDL-High density lipoprotein LDL-Low density lipoprotein Values are expressed in mean and standard deviation (Mean $\pm$ SD)

In the present study experimental rabbits show no major changes in the serum creatinine and liver enzymes AST and ALT levels before and experiment. Whereas significant difference in weight gain observed in high fat diet group(G-II) rabbits when compared to control(G-I) and Vanadium supplemented group (G-III) as shown in Table-1. Vanadium supplemented group(G-III) maintains weight similar to control group(G-I).

Plasma lipids levels shows significant differences between G-II and G-III. As shown in table-2 plasma Total cholesterol, LDL-cholesterol and Triglycerides were significantly decreased in G-III when compared to G-II after the experiment. HDL-cholesterol levels are similar in G-II & G-III. Whereas plasma lipids in G-I differs with G-II & G-III after the experiment.

Plasma glucose levels before and after experiments were almost similar in G-I and G-III, ( $300 \pm 12$ mg/dl) where as glucose levels are highly elevated in G-II ( $550 \pm 18$ mg/dl) after experiment. (Fig-1). Plasma insulin levels were significantly decreases in G-III ( $7.0 \pm 1.2$ mIU/ml) when compared to G-II ( $12.0 \pm 3.3$ mIU/ml) as shown in Fig-2.

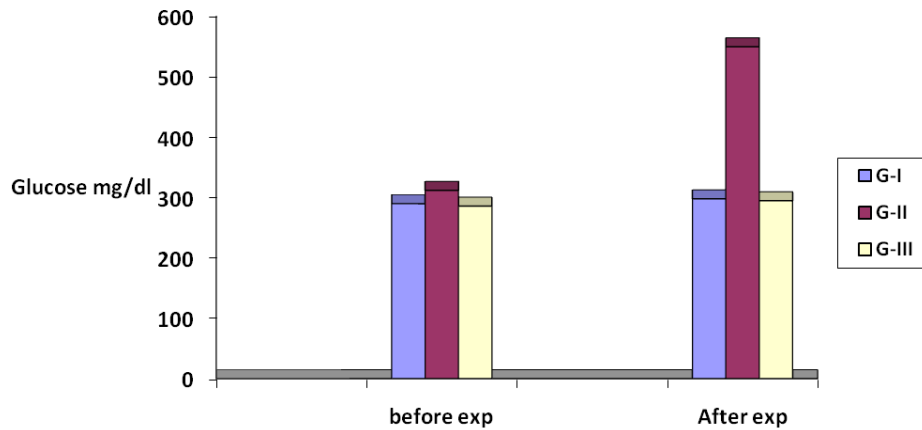


Figure-1 Plasma Glucose levels in rabbits before and after the experimental

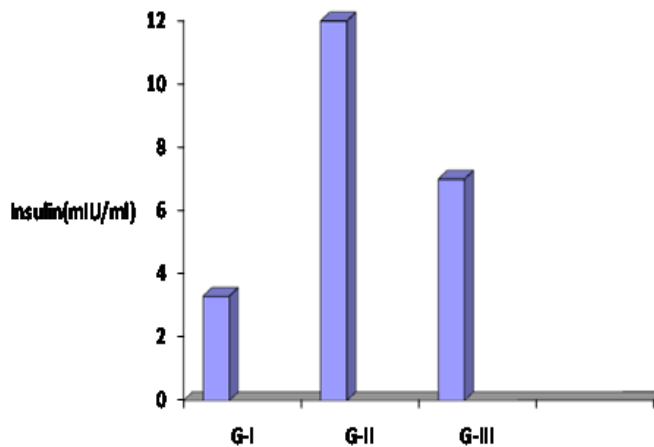


Figure-2 Plasma insulin levels in rabbits after experiment

## DISCUSSION

In the early 20th century, vanadium was thought to be a panacea. (Jackson DE.1912) Consequently, it has been long believed to have some pharmacological and nutritional importance. Vanadium compounds were studied as possible treatments for syphilis, and dental caries (Nielsen FH. 1998). In the present study vanadium supplemented group does not shows any hepato renal toxicity where serum creatinine and serum AST and ALT does not alters significantly after experiment. (Tabl-1). Several vanadium compounds have been developed and examined for their antidiabetic effects (Srivastava AK.2000). Our results supports the previous reports. Plasma levels of Glucose and insulin in Vanadium supplemented high fat fed (G-III) rabbits were markedly decreased than G-II rabbits. Vanadium compounds are glucose-lowering agents that are shown to mimic/enhance most of the metabolic actions of insulin both in vitro and in vivo. Several studies have demonstrated that vanadium treatment lowers plasma glucose levels in experimental models of type 1 diabetes and enhances insulin sensitivity in models of type 2 diabetes. Therefore, these compounds have gained attention as candidates for oral therapy in both types of diabetes (Lucy Marzban et al 2003)

Results from the present study confirm previous reports that feeding otherwise healthy rabbits a high fat diet results in hyperlipidemia, hyperglycemia, and hyperinsulinemia, (Hai-Dan Yuan,et al 2010).In our study G-II rabbits gains weight significantly than G-III.(Table-1).Anti lipidemic role of vanadium not yet established completely. Our results confirm the antidiabetic role of vanadium. Plasma lipids significantly reduced in Vanadium supplemented group(G-III).Our study is the first study using sodium vanadate for examining antilipidemic role of Vanadium. Mechanism by which vanadium reduces plasma lipids was not known, whereas studies demonstrate that vanadium increases lipoprotein lipase activity by which Very low density lipoprotein (VLVD) clearance takes place in the circulation ( Sera M ,et al 1990).

## CONCLUSION

The present study shows and confirms the antidiabetic and antilipidemic role of vanadium in the experimental rabbits. Supplementation of vanadium prevents hyperglycemia and cardiovascular risk factors like, insulin resistance and hyperlipidemia in diabetes mellitus, however further studies are required to elucidate the exact mechanism of actions.

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