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Complex of zinc and lectins from seeds of *Vigna radiata* as potential anti-diabetic agent

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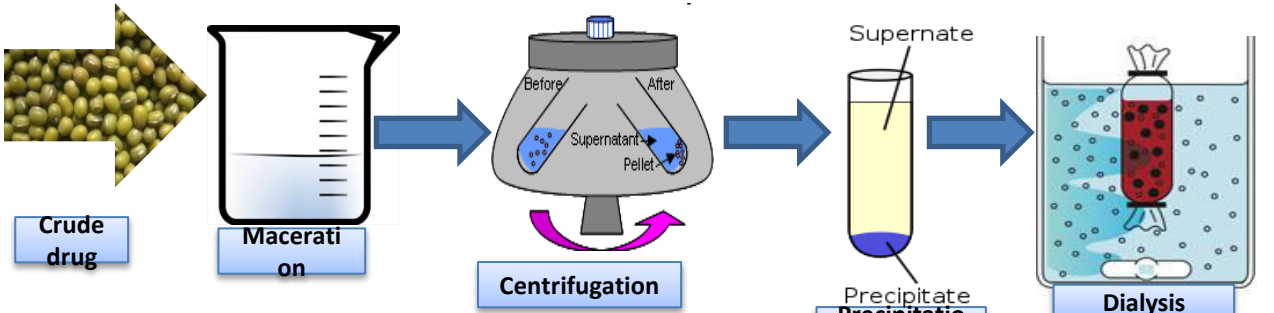
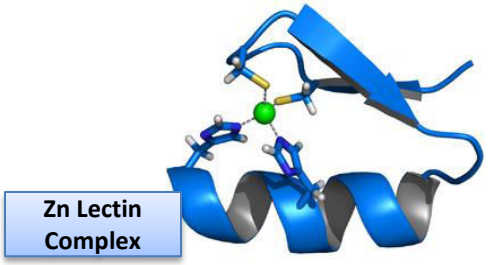




Abstract

The *V. radiata* seed was found to contain galactose specific lectin. The MBL-I (Mung Bean LectinI) may be a tetrameric protein with molecular weight 160-180 kDa and may be composed of identical or nearly identical relative subunits of molecular weight of 45-50 kDa. Amino acid analysis of purified Mung bean lectin by reverse phase HPLC revealed that it contains Glutamate in highest proportion followed by Aspartate and also contains Histidine, which indicates it has good zinc binding potential. Binding of the lectins with zinc improve overall stability and efficacy of the lectins. The antidiabetic activity was evaluated in Wistar rats using alloxan induced diabetic model and the studies indicated significant ($P<0.001$) reduction in elevated sugar levels. A probable mechanism of antidiabetic action may be insulinomimetic, since it was found to bind with insulin antibodies in Western Blotting Analysis. The lectin obtained from *V. radiata* seed and zinc lectin complex has good potential to be explored as a safe natural antidiabetic agent acting with controlled reduction in blood glucose levels. These findings indicate that the mungbean lectins and zinc lectins complexes have tremendous medicinal potential as a herbal antidiabetic drug.

Keywords: Lectins; Vigna radiata; antidiabetic activity

Introduction

- ✓Lectins from *Vigna radiata* are **sugar-binding proteins** that agglutinate cells
- ✓They have promising results in antidiabetic studies
- ✓ Insulin-Zinc complex gives better effect and stability.
- ✓ Based on this, the aim of this research was to investigate antidiabetic activity of lectins from *Vigna radiata* complexed with zinc in alloxan induced diabetic wister albino rats.

CHARACTERIZATION OF LECTINS

HEAMAGGLUTINATION ACTIVITY:

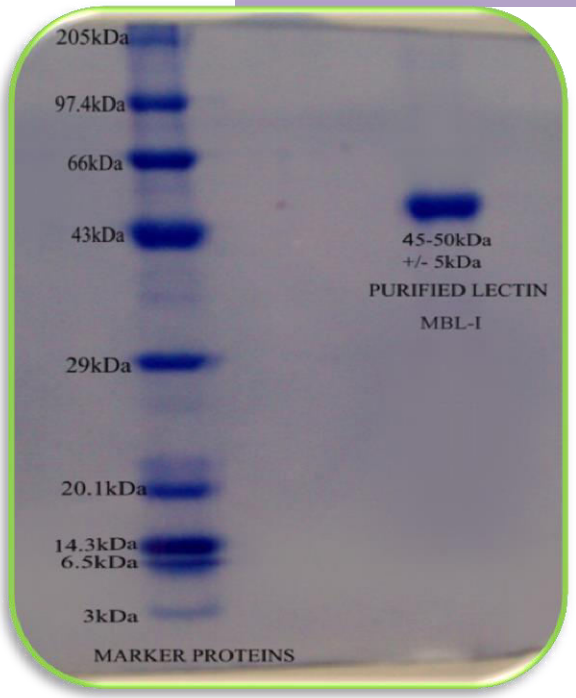
Performed by Standard dilution technique using rabbit erythrocyte suspension.

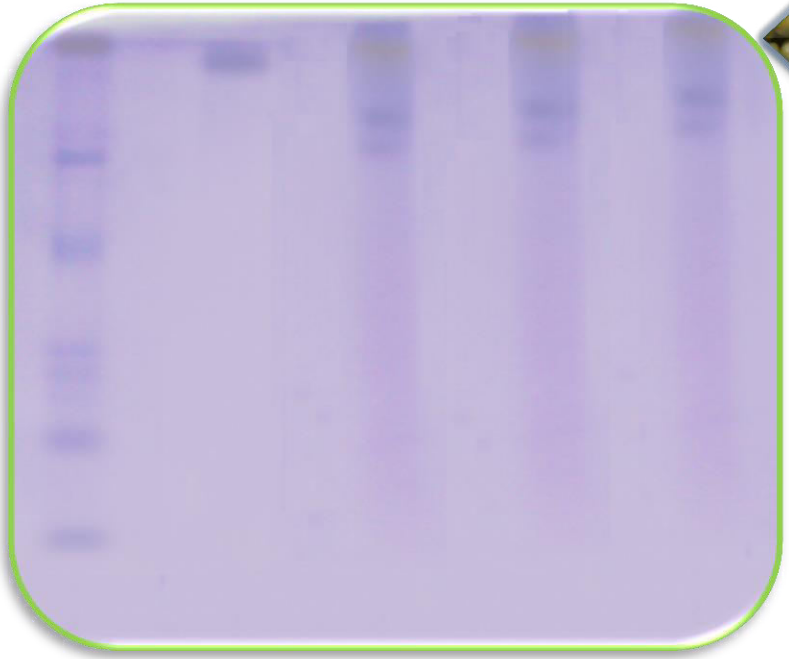
The effect of sugars, pH and temperature on hemagglutination activity was studied.

ASSAY OF α AND β GALACTOSIDASES:

α Galactosidase activity is more as compared to the β Galactosidase in *V.radiata* samples.

GEL ELECTROPHORESIS



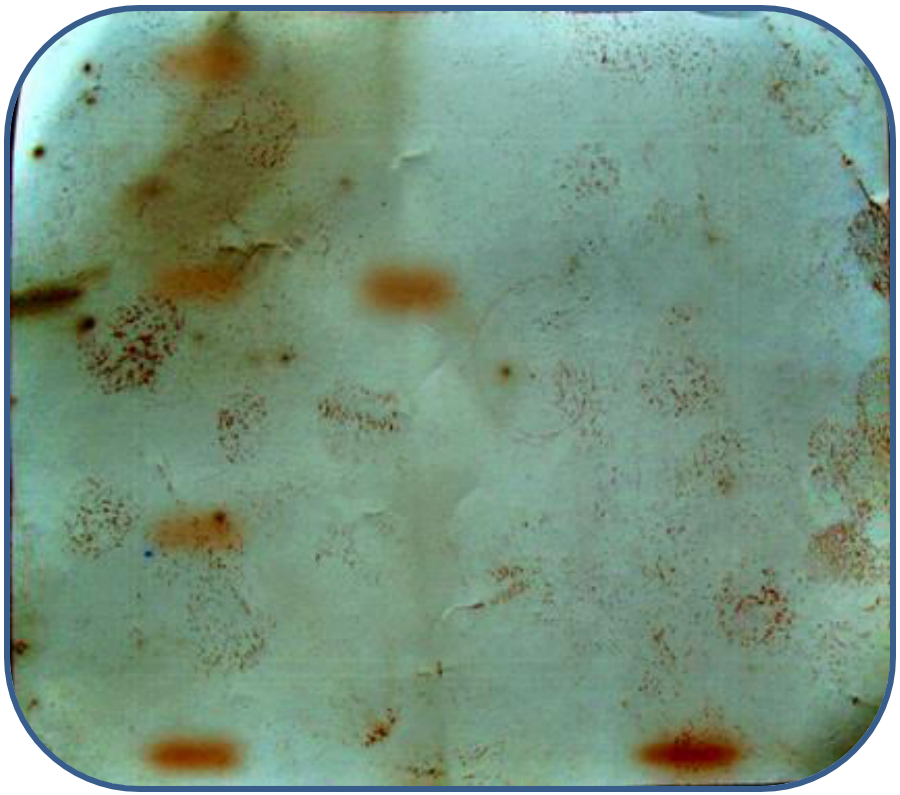


SDS-PAGE data revealed the presence of a single sharp in the region of 45-50 kDa

Native-PAGE data revealed the presence of a single sharp in the region of 160-180 kDa.

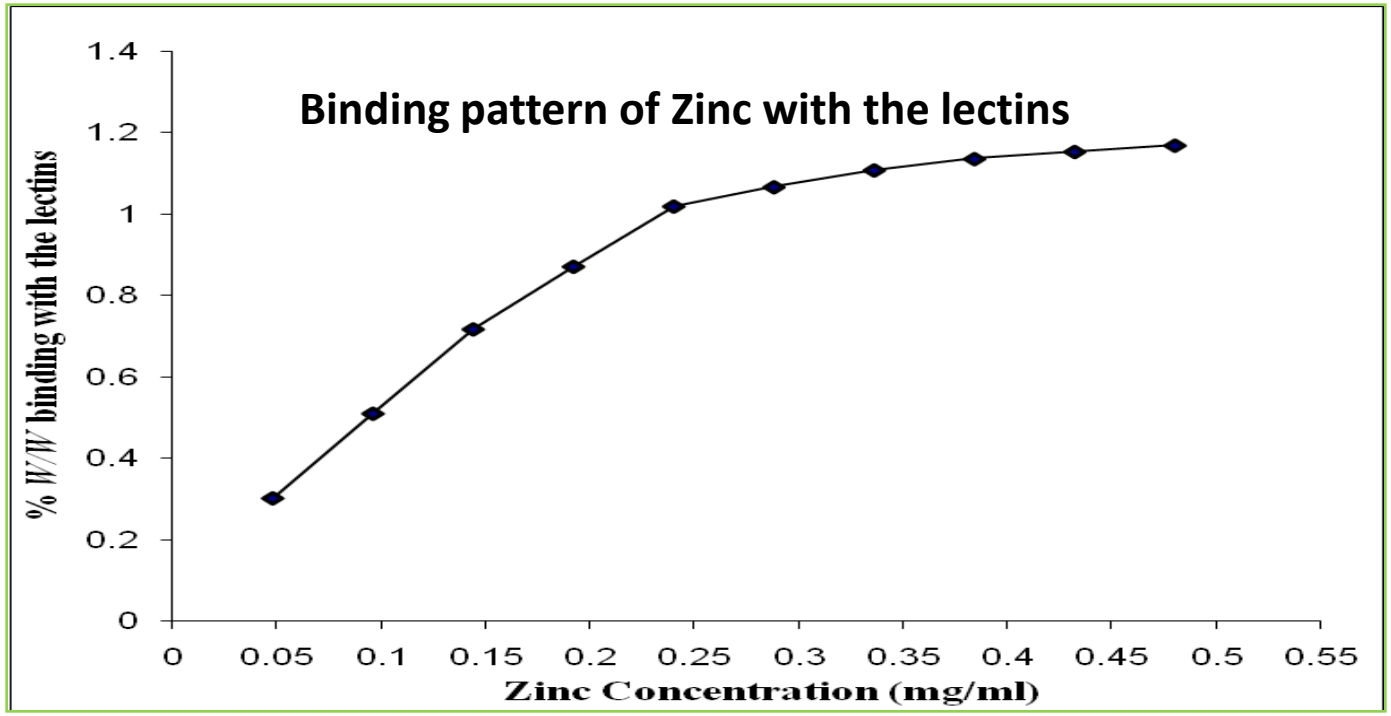
All these data indicate that the *V. radiata* seed lectin may be a tetrameric protein with a relative molecular weight of about 160-180 kDa and identical or nearly identical subunits of 45-50 kDa.

WESTERN BLOTTING



Western Blotting analysis shows that purified lectin has fewer insulin binding sites than freeze dried lectins but may have the mechanism of action as that of insulin in lowering the elevated blood glucose levels.

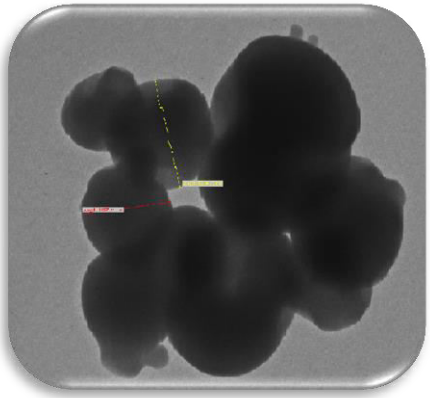
PREPARATION OF ZINC LECTINS COMPLEX AND ITS EVALUATION

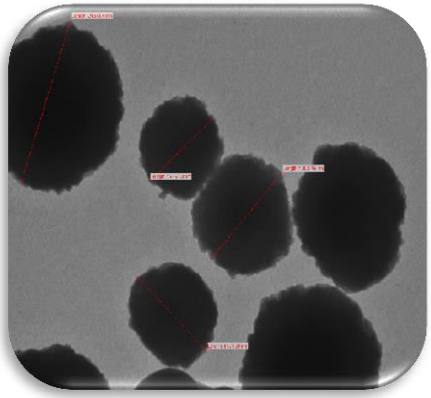


The maximum % w/w binding of zinc with the lectins was found out to be 1.178 % w/w at 1000 µg/ml of zinc chloride (0.47996 mg/ml of Zn^{+2})

TEM & DSC Analysis of Lectins and Zinc Lectin Complex

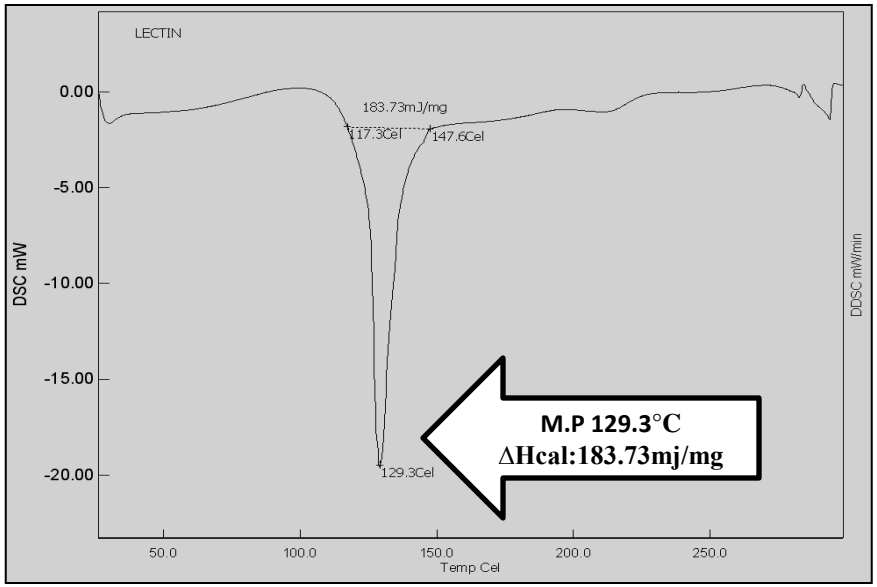
Avg Particle Size
1.259µm



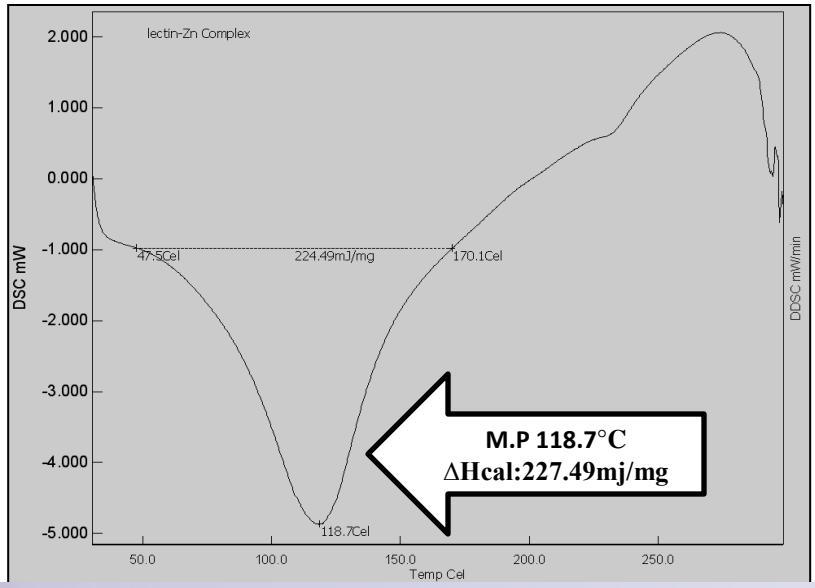


Avg Particle Size
1.326µm

Spray Dried Lectins



Spray Dried Lectins and zinc complex

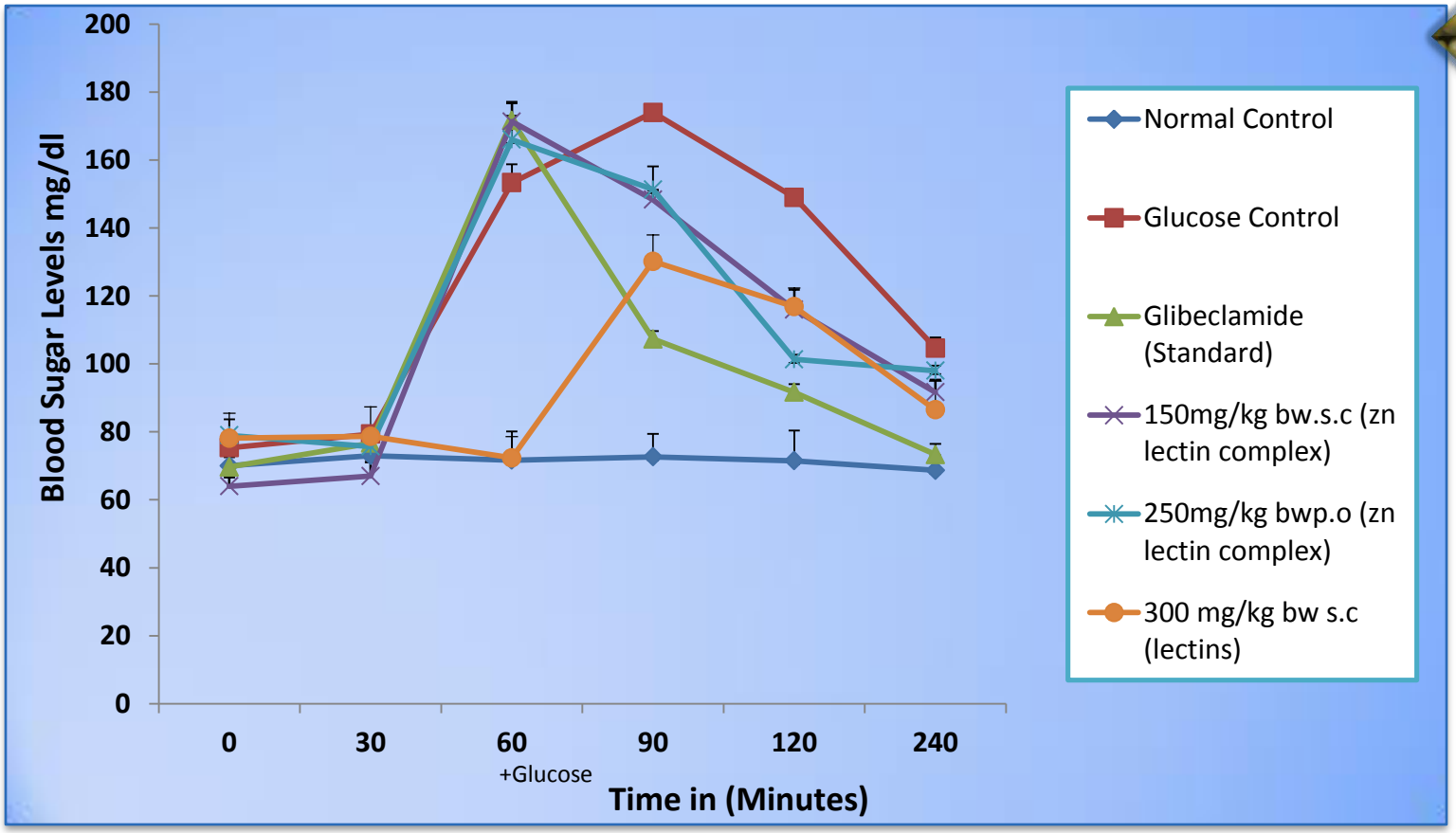


Acute toxicity studies (as per OECD 425)

Treatment group (Female Wistar rats)	Dose	Number of animals	Mortality observed
Saline suspension of lyophilized crude lectins	2000 mg/kg b.w.s.c.	06	No mortality
	2000 mg/kg b.w.p.o.	06	No mortality
Saline suspension of Zinc freeze dried lectins complex	2000 mg/kg b.w.s.c.	06	No mortality
	2000 mg/kg b.w.p.o.	06	No mortality

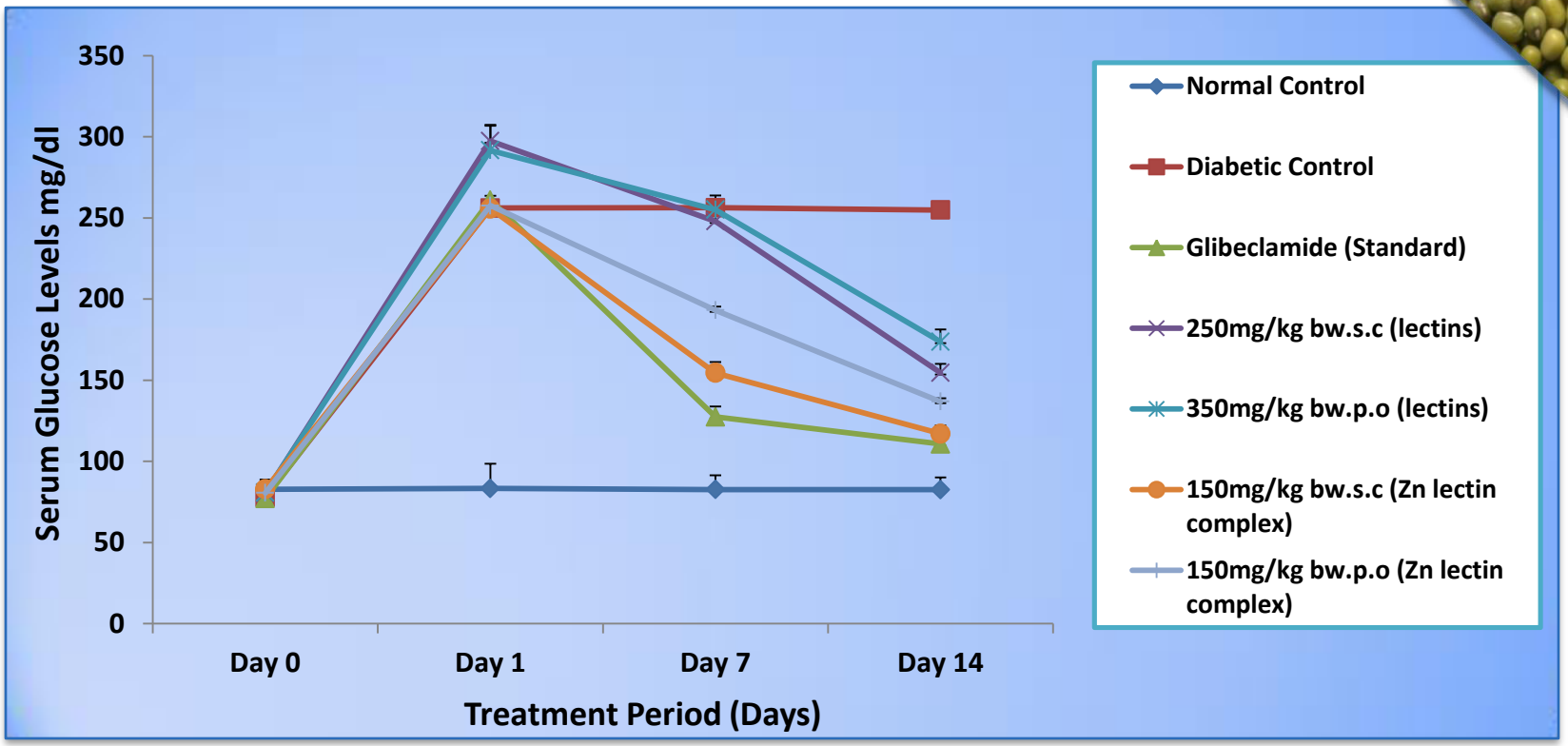
Saline suspension of crude lectins & Zn lectin complex is practically safe & its LD50 (MTD) is higher than 2000 mg/kg

ORAL GLUCOSE TOLERANCE TEST (OGTT)



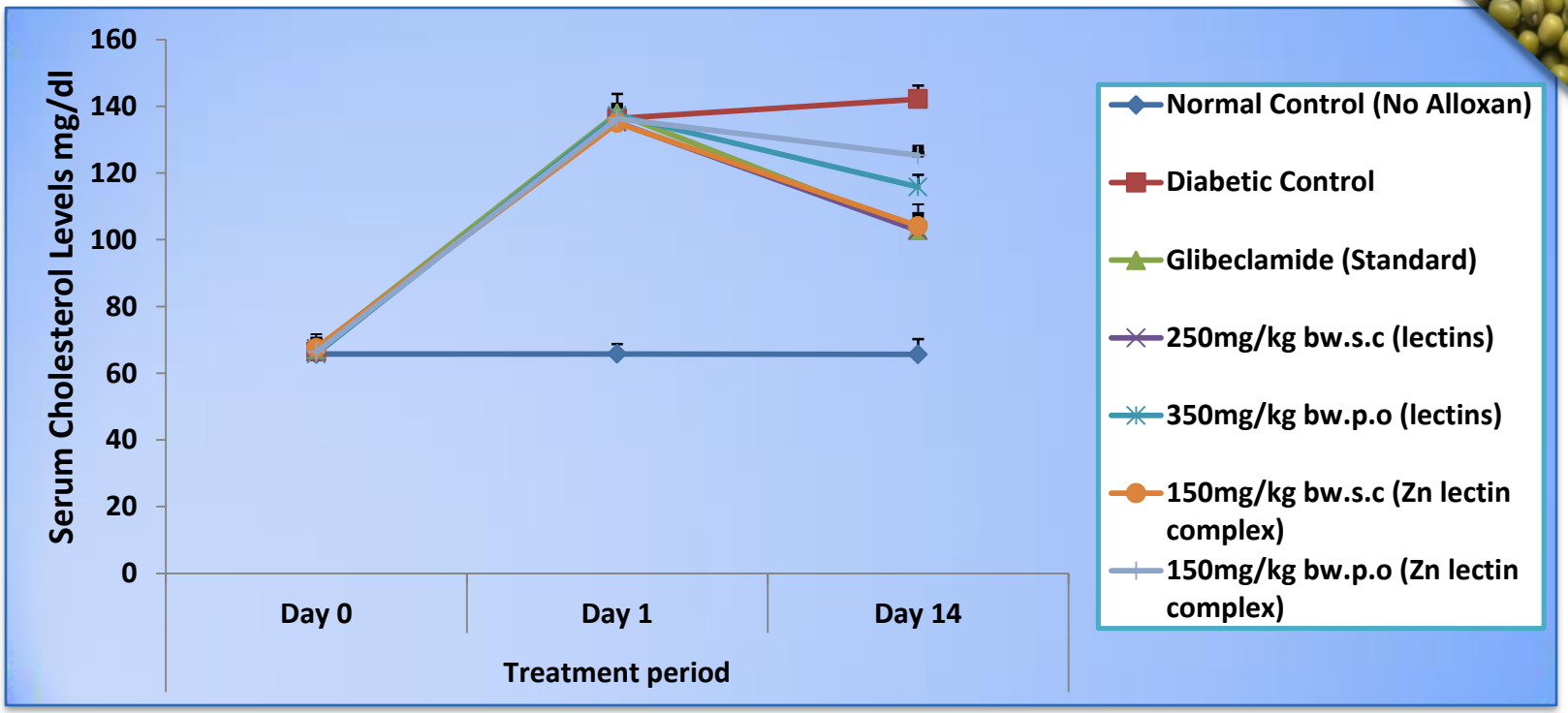
The risk of hypoglycemia observed in Glibenclamide treated group is not observed in lectins as well as Zn lectins complex treated group.

EFFECT OF FREEZE DRIED LECTINS & ZINC LECTIN COMPLEX ON SERUM GLUCOSE LEVELS



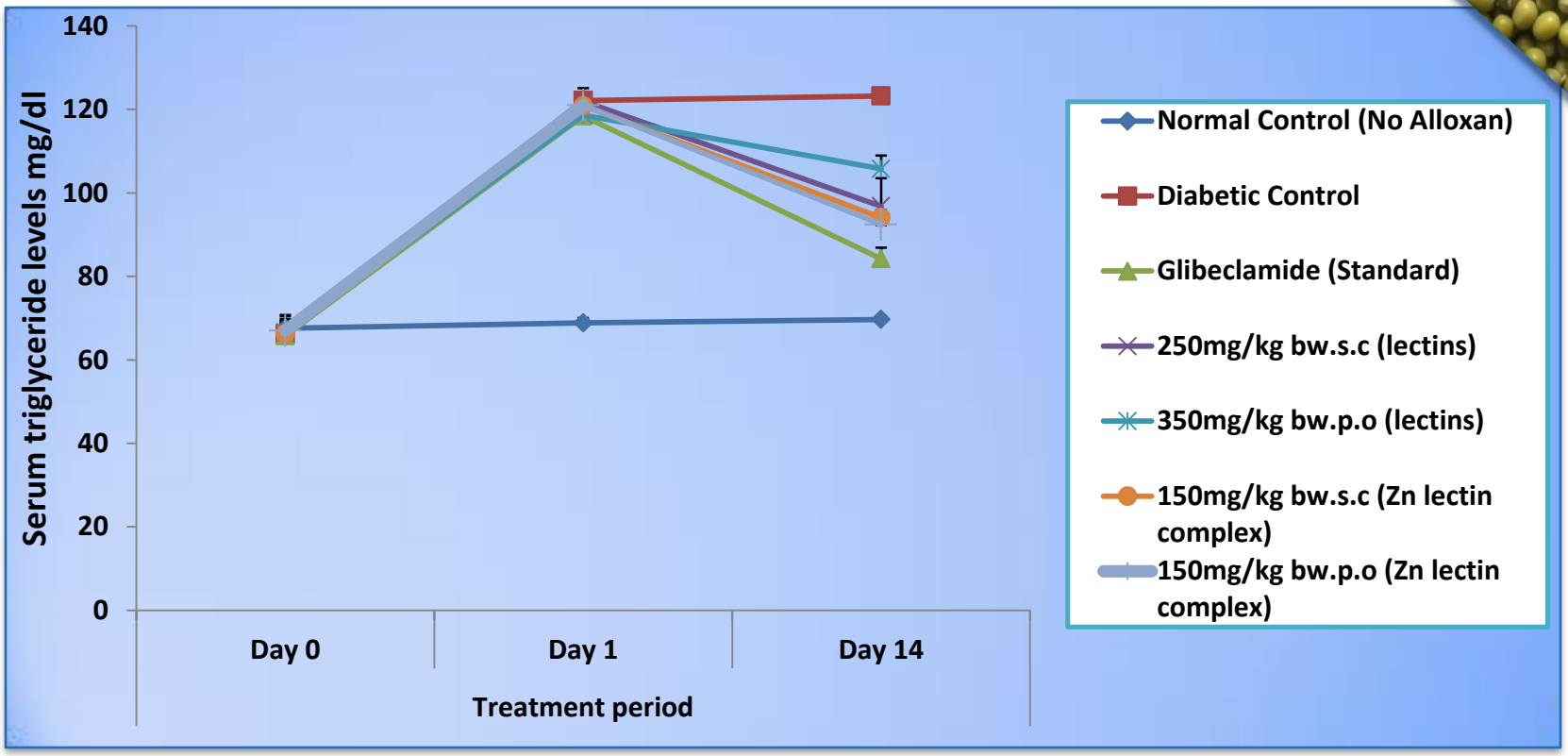
Lowering of the serum glucose levels by Zn lectin complex treated group is at lower dose than lectins for both oral and subcutaneous route of administration.

EFFECT OF LECTINS & ZINC FREEZE DRIED LECTINS COMPLEX ON SERUM TOTAL CHOLESTEROL LEVELS



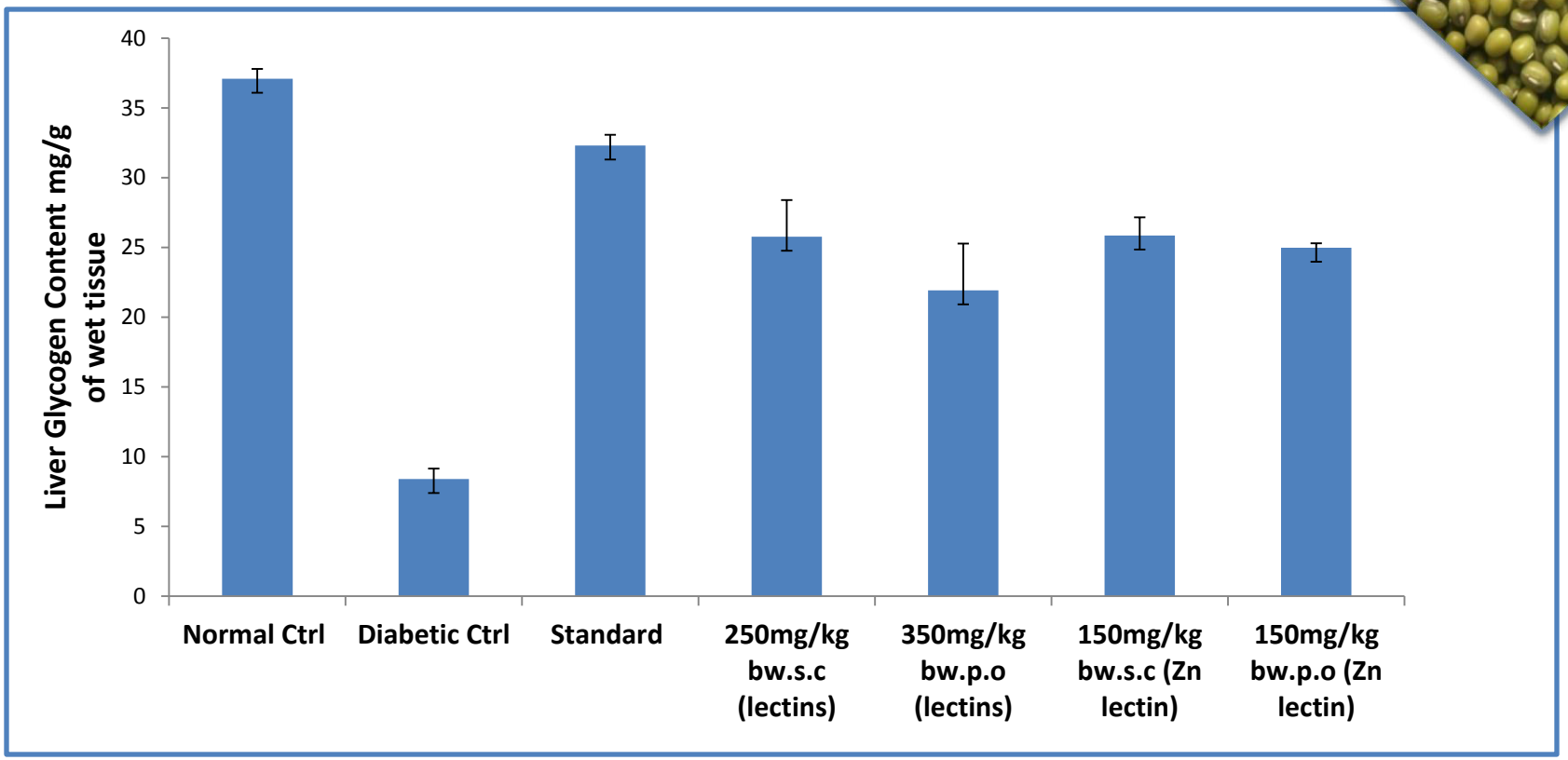
Decrease in total serum cholesterol levels indicate that some of the serious symptoms related to high cholesterol levels can be controlled by both lectins & zinc lectins complex treatment.

EFFECT OF LECTINS & ZINC FREEZE DRIED LECTINS COMPLEX ON TOTAL SERUM TRIGLYCERIDES LEVELS



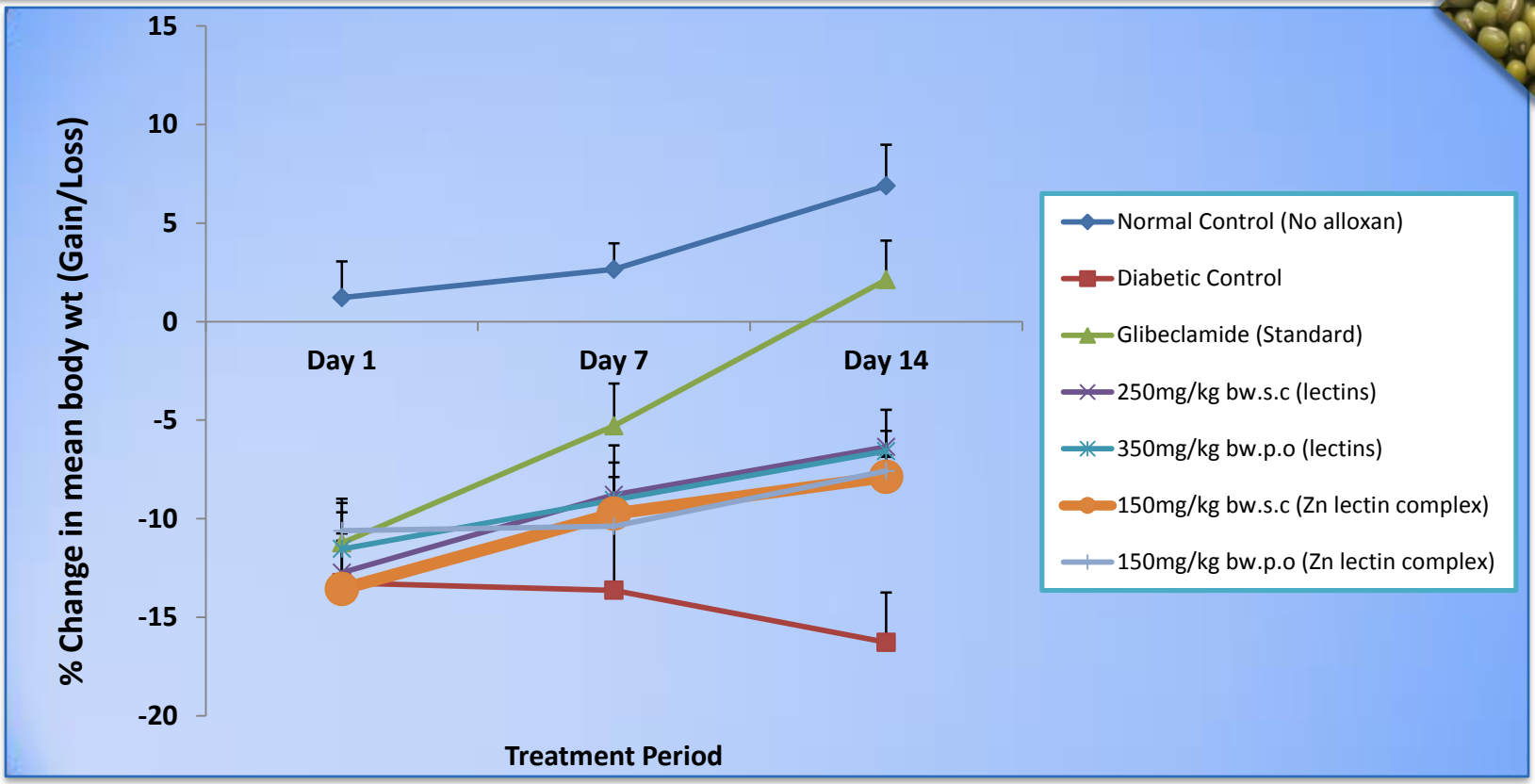
The reduction in the elevated triglycerides levels was seen on treatment with lectins & Zn lectin complex. However, Zn lectins show the effect at much lower dose than lectins.

EFFECT OF LECTINS & ZINC FREEZE DRIED LECTINS COMPLEX ON LIVER GLYCOGEN CONTENT



Glibenclamide, Lectins & Zn lectin complex show restoration of liver glycogen levels which suggests lectins may bind to allostearic sites of insulin thus promoting action of insulin.

EFFECT OF LECTINS & ZINC FREEZE DRIED LECTINS COMPLEX ON BODY WEIGHT



The diabetic rats treated with lectins & Zn lectin complex by subcutaneous as well as oral route did not reveal weight gain respectively as compared to standard Gilbenclamide.

CONCLUSION

The *Vigna radiata* seed contains **galactose specific lectin.**

The MBL-I may be a **tetrameric protein** with molecular weight 160-180 kDa and may be composed of identical or nearly identical relative subunits of molecular weight of 45-50 kDa.

Binding of the lectins with zinc **improves stability and efficacy of the lectins.**

The lectin obtained from *Vigna radiata* seeds and zinc lectin complex has a **good potential to be explored as a safe natural antidiabetic agent** acting with controlled reduction in blood glucose levels.

Future Scope

- Antidiabetic potential of zinc lectins complex can be further explored by Streptozotocin model.
- Insulin mimicking activity can be studied for the lectins using in vitro, in vivo models to establish mechanism for antidiabetic activity and cholesterol lowering effect.

References

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Patent Filed: Antidiabetic Lectins from *Vigna radiata* and its complex with Zinc., Indian Patent Office August 25, 2010.

(Patent Appl No. 2370/MUM/2010)

A NATURAL ANTIDIABETIC AGENT CAN BE ALWAYS HELPFUL IN PROPHYLAXIS PATIENTS