UTILIZATION OF FIBROLYTIC ENZYMES FOR IMPROVING SUGAR BEET PULP DIGESTIBILITY AS A COMPONENT IN DAIRY ANIMAL FEED

By

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B.Sc. Agri. Sc. (Animal production), Cairo University, 2004

M.Sc. Agri. Sc. (Animal production), Cairo University, 2009

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ABSTRACT

Hossam El-Deen Hussein Azzaz Abd-El-Fattah: Utilization of Fibrolytic Enzymes for Improving Sugar Beet Pulp Digestibility as a Component in Dairy Animal Feed. Unpublished Ph.D. Thesis, Department of Animal Production, Faculty of Agriculture, Ain Shams University, 2013.

The current study aimed to produce pectinase to be involved in rations of lactating buffaloes. The maximum production of pectinase by *A.niger* was achieved at16% sugar beet pulp concentration, inoculum size of 5%, 48 hr of incubation period, initial pH of growth medium 7.0, yeast extract as a nitrogen sources at a concentration of 0.33 g N/l. Two experiments were carried out to evaluate the effects of fibrolytic enzymes supplementation on *in vitro* degradation of sugar beet pulp and *in vivo* nutrients digestibility, milk yield and its composition by mild-lactating buffaloes. In the *in vitro* experiment, dry matter and organic matter disappearance were determined for sugar beet pulp supplemented separately with laboratory produced fibrolytic enzymes (Asperozym) and commercial fibrolytic enzymes source (Tomoko®) at 3 levels (0, 1, 1.5, and 2 g / kg DM). Increasing the Asperozym and Tomoko® supplementation levels up to 2g/kg DM exhibited the highest ($P<0.05$) values of IVDMD and IVOMD. In the *in vivo* experiment, fifteen mild-lactating buffaloes after 3 months of parturition were divided into three groups, five animals each, using complete random design. The first group was fed on 45% concentrate feed mixture (CFM), 30% corn silage ,15% dried sugar beet pulp and 10% rice straw (control ration). The second group was fed control ration supplemented with Asperozym at 2 g/kg DM (R_1), while the third group was fed control ration supplemented with Tomoko® at 2 g/kg DM. (R_2). Asperozym and Tomoko® supplementation significantly ($P<0.05$) increased DM, OM, CF, NFE, NDF digestibility for treated groups compared with the control group, while blood plasma parameters, milk yield and its composition did not

significantly (P>0.05) change among all groups. Fibrolytic enzymes with its immense importance are being imported for use in Egypt at a high cost. The local production of such enzymes reduces the cost of importation and encourages self-reliance.

Key words: Pectinase production, Fibrolytic enzymes, Sugar beet pulp, Nutrients digestibility, Milk yield and its composition, Mild-lactating buffaloes.

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CONTENTS

LIST OF ABBREVIATIONS

ADF	Acid Detergent Fiber
ADL	Acid Detergent Lignin
ALT	Alanin aminotransferase
AST	Aspartate aminotransferase
Asperozym	Laboratory produced fibrolytic enzymes source
BPPM	Beet Pulp Powder Medium
CF	Crude Fiber
CFM	Concentrate Feed Mixture
CMC	Carboxymethyl-Cellulase
CP	Crude protein
DCP	Digestible Crude Protein
DDGS	Distillers Dried Grains with Soluble
DM	Dry matter
EE	Ether Extract
FCM	Fat Corrected Milk
IVDMD	In vitro Dry Matter Disappearance
IVOMD	In vitro Organic Matter Disappearance
L.E./h/63d	Egyptian pound per Head per 63 Day
NDF	Neutral Detergent Fiber
NFE	Nitrogen Free Extract
OM	Organic Matter
PDA	Potato Dextrose Agar
R_1	Control ration + Asperozym at 2 g/kg dry matter
R_2	Control ration + Tomoko® at 2 g/kg dry matter
SNF	Solids-Not-Fat
TDN	Total Digestible Nutrients
Tomoko®	Commercial enzymes source
V/V	Volume per Volume
W/V	Weight per Volume

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I. INTRODUCTION

The increasing demand for milk and input costs in the dairy industry requires integrated strategies to increase production efficiency. One way of increasing production efficiency would be to increase nutrients bioavailability of feedstuffs. **Yang *et al,* (2000)** demonstrated that, digestion of fibrous substrates in the rumen is slow and incomplete and can limit milk production and increase the cost of production, so a continual search for new additives that can be enhance feed utilization by ruminants is very important approach.

Recent advances in fermentation technology and biotechnology have allowed for production of large quantities of biologically active enzymes that can be used as livestock feed supplements **(McAllister *et al.,* 2001).** According to **Sheppy (2001)**, there are four main reasons for using enzymes as livestock feed supplements: 1) to break down anti-nutritional factors; 2) to increase the availability of starches, proteins and minerals enclosed within fiber-rich cell walls; 3) to break down specific chemical bounds in raw materials which are not usually broken down by the animals' own enzymes, thus releasing more nutrients; and, 4) to supplement the enzymes produced by young animals.

Many researchers has demonstrated that supplementing diets of dairy animals with fibrolytic enzymes can improve feed utilization and animal performance by enhancing fiber degradation *in vitro* **(Hristov *et al.*, 1996; Gado *et al.*, 2007; Rodrigues *et al.*, 2008; Azzaz *et al,* 2012b)** and *in situ* **(Feng *et al.*, 1996; Lewis *et al.*, 1996; Tricarico *et al.*, 2005; Krueger *et al.*, 2008).** A number of studies **(Yang *et al.*, 1999; Gado *et al.*, 2007; Gado *et al.*, 2009; Azzaz *et al,* 2012b; Kholif *et al.*, 2012)** have shown that using fibrolytic enzyme supplements in dairy animal's diets can increase milk production, while others **(Chen *et al.*, 1995, Luchini *et al,* 1997, Nussio *et al,*. 1997, Beauchemin *et al.*, 2000;**

Bowman *et al,* 2002; Ballard *et al.* 2003; Reddish and Kung, 2007) reported no effects on milk production.

Inconsistency of responses to enzyme supplementation may be due to a number of factors, including whether the cows were in negative energy balance and capable of responding to increased available energy. Other factors that could account for inconsistent responses include diet composition, type of enzyme used, level of enzyme provided, enzyme stability, and method of application **(Rode *et al.*, 2000).**

Previous studies from our group **(Azzaz *et al.*, 2012 a,b)** have shown that the maximum production of laboratory produced cellulase (Asperozym) by *A.niger* was achieved when wheat straw was used as a sole carbon source at a concentration of 20% (W/V), 4% inoculum size, 72 h incubation period, initial pH 6 of growth medium and meat extract as a sole nitrogen sources at a concentration of 0.33 g N/L. Asperozym has been shown to improve IVDMD and IVOMD of banana wastes, goats ruminal fermentation, nutrient digestibility as well as milk yield and 4% fat corrected milk.

Fibrolytic enzymes with its immense importance are being imported for use in Egypt at a high cost. The local production of such enzymes may reduce the cost of importation and encourage self-reliance.

This study was carried out to:

1- Produce pectinase from *A. niger* under the optimum conditions and evaluate the effects of resultant pectinase on banana fiber degradation by using electronic microscope.

2- Evaluate the potential use of laboratory produced fibrolytic enzymes (Asperozym) for improving digestibility of sugar beet pulp compared (*in- vitro*) with commercial fibrolytic enzymes source (Tomoko®).

3- Investigate the impact of adding Asperozym and Tomoko® to rations of mid-lactating buffaloes on nutrients digestibility, blood parameters, milk yield and composition.