Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2015, 7(5):951-954

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Innovative means for regulating global warming through indigenous veterinary system: Are we missing sustainable solutions?

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ABSTRACT

Global warming has been a cause of concern as steadily the environmental temperature of the planet earth has been on surge. This had resulted in severe damage to several ecological systems and ramifications were yet to unfold. These changes were result of several developmental activities, including exploitation and destruction of natural resources. Research community and concerned stakeholders of the society are trying various options throughout the world in minimizing this impact and to protect the planet. Of the several attempted options, livestock particularly ruminants were identified as a factor in heaping methane production. The production of this gas is an inherent part of ruminant digestive system by utilizing natural resources thereby enabling food security globally. The vast human population in the world have to depend on livestock for sustaining their livelihood. Hence, alternative approaches were tried such as changing feeding pattern to curtail greenhouse gas emission from livestock. Adequate resources in terms of quality manpower, financial support were afforded to find sustainable solution(s)in intensive dairy production system. In most of these efforts, the balancing act of natural resources, more specifically role of indigenous knowledge systems were not exhaustively studied. In majority of incidences these veterinary knowledge system sustained by community were viewed in terms of prevention and treatment of livestock ailments and not beyond. This research study had attempted to understand the effect of common knowledge of these environment friendly solutions in minimizing production of methane. The implications of these findings will enhance wider scope of indigenous veterinary system beyond welfare, productivity of ruminant ecological systems. This knowledge practiced by farming community acts as an innovative means to control greenhouse gas for extensive dairy production system.

Keywords: Enteric Methane, Global Warming, Indigenous Veterinary System, Ruminants, extensive system

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INTRODUCTION

Rumen fermentation, a natural process of utilizing feed through anaerobic digestion produces methane among ruminants. Methanogens are responsible for removal of hydrogen resulting in methane (CH_4) production in rumen [12]. These bacterial populations utilize hydrogen and carbon dioxide (CO_2) derived from carbohydrate digestion for CH_4 formation. Ruminants in the process of digestion contribute to greenhouse gas (GHG), methane which has huge global warming potential than CO_2[1, 17]. It was estimated that livestock production system has been contributing to 18 percent of anthropogenic GHG emissions annually [15]. The resultant effect of production of methane results in energy loss of at least 2 to 12 percent in farm animals [9].

Since, 1989 estimation of GHG emissions were based on standard methodology advocated by Intergovernmental panel on Climate change (IPCC). Thus earlier efforts were mostly towards advocating uniformity in quantification and identification of sources of GHG emissions [19]. Further, in case of livestock rearing, world-wide the system of farming activities had contributed significantly in different level of CH_4 emission. It was found that similar body

mass small ruminants had higher methane production in extensive system than semi intensive, intensive systems of livestock farming[13].

These extensive and semi-intensive farming systems are paramount for poverty alleviation, food security to mankind. In most developing countries, agriculture is characterised by low input and low output system and such economies increasingly rely on livestock intensification [10]. In these smallholder livelihood systems, contribution of livestock has been well recognized [11]. However, due to dairy intensification, the nature of food choices were discussed among European countries in terms of protecting environment. These approaches will have direct economic impact on stakeholders in livestock industry [20]. This had led to several intervention measures to effectively combat methane production more particularly in intensive systems than to extensive system of dairy production. The adaptability of using multiple approaches for sustainable intensification and climate smart agriculture were important for global food and nutritional security [2].

Minimizing impact of GHG by involving livestock owners have to be part of national policies for successful intervention, as most studies remained at institutional boundaries. Mitigation through dietary management has been identified as most promising though vaccine, animal selection strategies were evolving[14]. Inclusion of low price feed supplements with low carbon credit were recommended to improvise economic situation of dairy farms [1, 16]. However, the emission rate of GHG increases by one percent each year from cattle and sheep [6]. In this context, Indigenous knowledge system that were already practiced and sustained by pastoralists needs to be evaluated. Wider horizon of imagination is needed for scaling up these practices towards environmental solutions. The research study was carried out to understand the role of simple common digestive supplements used in indigenous veterinary system in reducing CH_4emission.

EXPERIMENTAL SECTION

Collection and preparation of rumen contents

The goat ruminal contents were collected from slaughter house and carried to laboratory in air tight pouch. The ruminal contents were strained through muslin cloth with the help of artificial saliva.

Maintenance of anaerobic condition in artificial rumen chambers

In order to maintain anaerobic condition, carbon dioxide was blown directly to the container containing strained rumen fluid. The water bath of in vitro rumen model was filled with ordinary water and heated to 38^0Cbefore start of experiment. This temperature was maintained up-to 30minutes to prevent any shock to rumen microflora due to temperature difference.

Adaptation of rumen microflora

Ruminal chambers were filled with strained ruminal fluid of about one litre and assembly were fitted as per manufacturer's instruction (Rumen In vitro model: RUSI-E-TEK, EAGA tools and instruments, Chennai). Subsequently, ruminal contents were keptin ruminal chambers for 2 hours at 38^0 C and in anaerobic condition in enabling adaptation of rumen microflora.

In-vitro rumen fermentation

The salivation tube, gas collection bags, overflow tubes were fitted and experiment was started. The saliva was regulated in cyclic manner such that after each 20seconds the saliva was released for duration of 4 seconds. The test medications was enclosed in non-digestive semi permeable membrane pouch in ruminal chamber and assembly was marked as Test chamber. In order to evaluate the efficacy of test preparation, the pH parameter was noted in control chamber (without medication) and test chamber (with medication) for a period of 0, 1, 2, 3 and 4 hours duration. The experimental protocol was carried out as per earlier studies [8].

Quantification of viability of protozoa and total gas production

The gas produced was quantified after 4 hours of experimentation. The viability of protozoa was quantified based on observing motility and density of protozoa. They were observed under 40X microscope as per standard method. The rating was based on motility of protozoa in rumen liquor, a score of +++ indicates normal digestive function and ++ suggest poor digestion of feed due to abnormal rumen fermentation. The total number of protozoa was counted with help of haemocytometer and results were expressed as total count per ml (n x 10^5).

Analysis of results

The results were compared and analysed statistically [4].

RESULTS AND DISCUSSION

Homogenous rumen environment: Invitro Fermentation

The calculated coefficient of variability of pH for negative control rumen chamber was 3.29 percent and for test medication it was 1.15 percent. This indicated that supplementation with ginger had minimized variability and resulted in more consistent pH during rumen fermentation. It was found that the period of time the pH was below optimal was more critical in digestion than mean pH, optimal pH among ruminants [3]. The suboptimal pH over a period of time might have decreased digestion efficiency of fibre in control chamber. These variability in rumen fermentation affects acetate: propionate ratio, thereby effectively influencing the formation of methane for per unit rumen fermented feed.

Minimizing total rumen gas production: utilization of energy

The total quantity of gas produced was quantified after 4 hours of fermentation and found 1730 ml in control chamber. The ginger supplemented chamber it was found to be 1530ml. The reduced level of gas production can be attributed to effective fermentation process. The decrease in the level of gas production has been reported elsewhere [8]. The reduction in measured gas between negative control chamber and test chamber indicated the utilization of feed ingredients in normal rumen fermentation process. This had contributed to minimum loss of energy in the simulated rumen experimental condition.

Protecting ruminal protozoa and sustaining buffering function of rumen flora

Methane is produced by highly specialized bacteria and depends on several factors including chemical composition of feed [18]. The herbal test medication Ginger (*Zingiber officinale*) was found to maintain mean pH of rumen content at 6.10 whereas in negative control chamber it was 5.78 [8]. The rumen microbes utilize the carbohydrate and tend to decrease the pH steeply due to bacterial fermentation. However, these activities were minimized by the buffering capacity of rumen protozoa so as to prevent sharp decline in pH [7].

Table 1. Impact of indigenous veterinary medication on viability of Rumen protozoa

SN	Medications	Before (0 hours) Start of experimentation		After (4 hours) *Invitro* Rumen fermentation	
		Motility	Density	Motility	Density
1	Control chamber (Negative)	3+	3+	2+	3+
2	Test Chamber (Ginger supplementation)	3+	3+	3+	3+

Table 2. Impact of indigenous veterinary medication on total protozoan count

SN	Medications	Before (0 hours) Start of experimentation (n X 10^5)	After (4 hours) *Invitro* Rumen fermentation (n X 10^5)	Percent change (%)
1	Control chamber (Negative)	12.5	10	20.00
2	Test Chamber (Ginger supplementation)	11.5	10.25	10.86

The protozoan motility and total protozoan count were evaluated after 4 hours of fermentation (Table 1, 2). It was found that test chamber supplemented with ginger had normal digestive function. The percent change in the protozoan count was more in control chamber (20.00%) than test chamber (10.86%). The supplementation of herbal medication had protective effect on rumen protozoa and sustained protozoan viability, density than control chamber during the experimentation period. It was referred that protozoans of the genera such as Entodinium, Polyplastron, Epidinium and Ophryoscolex had shared relationship with methanogens. The methanogenic bacteria from orders Methanobacteriales and Methanomicrobiales are more associated with them[5]. The rumen fermentation is a complex process; hence the symbiotic relationship of methanogens associated with protozoa needs to be interpreted cautiously.

CONCLUSION

Nutritional strategies are paramount for minimizing and for reduced production of methane emission in livestock. Feeding of concentrate tend to ease the situation, however it may not be possible under extensive and semi-intensive system to feed concentrates to livestock due to cost factor. Henceforth, research needs to be oriented towards indigenous veterinary system to bring-out appropriate policy and implementation strategies. The supplementation of ginger (*Zingiber officinale*) had confirmed an effective role in minimizing methane formation for unit rumen fermented feed. It was also found that this indigenous knowledge system had influenced variability of pH in rumen fermentation and attributed towards minimum loss in energy. The positive effect on rumen protozoa had sustained the buffering activity and maintained desirable digestive conditions. These common indigenous knowledge may be advocated to ruminant systems for minimizing production of greenhouse gas.

Acknowledgements
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