OPTIMUM UTILIZATION OF SOME GREEN FODDERS BY RUMINANTS

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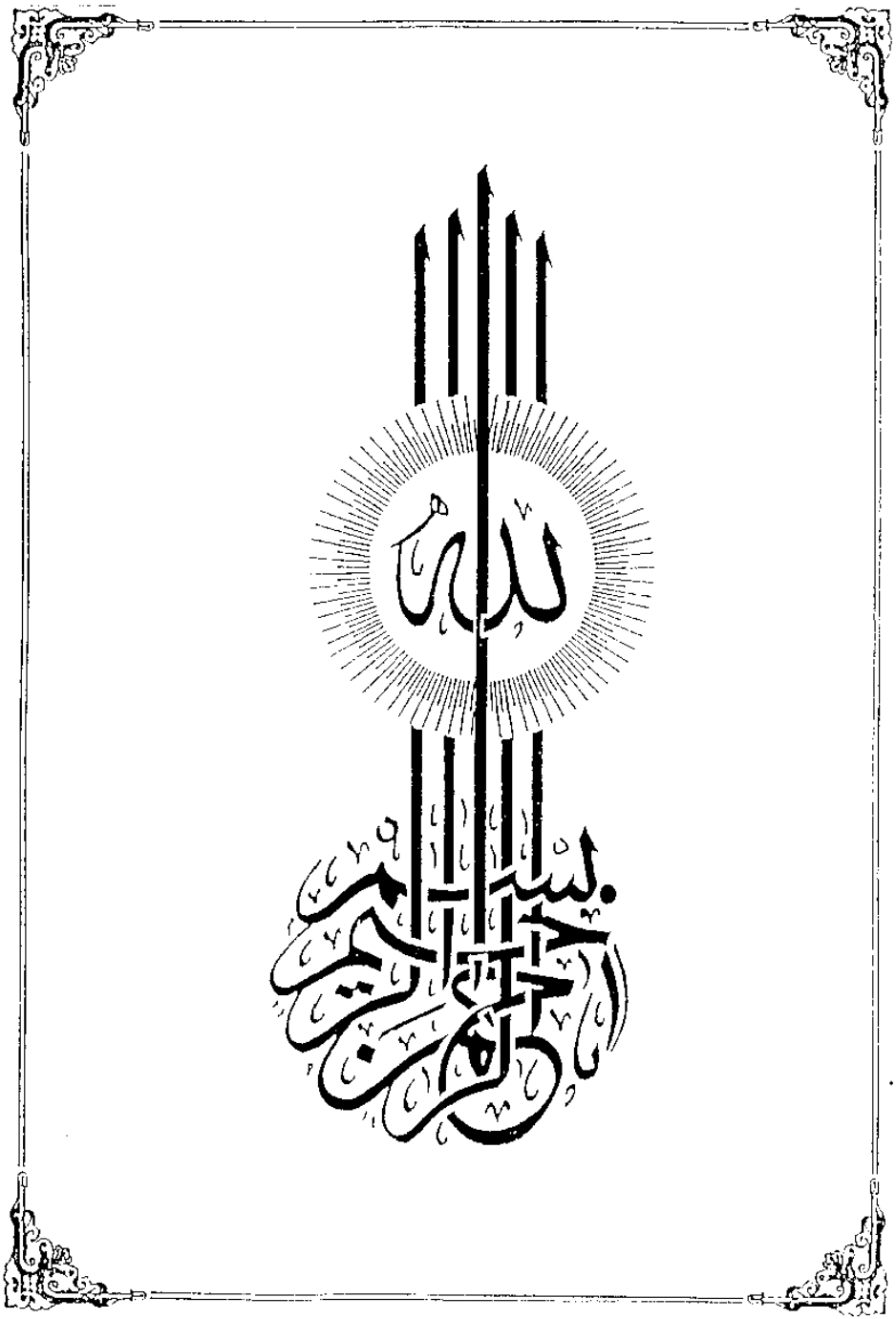

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Contents

INTRODUCTION

The world population is expected to double within 30 years from now. It has been anticipated that by the year 2000 the population of Egypt may reach 70 million, if birth control measures are maintained within the present limits. On both international or national level there is an urged situation to explore unconventional sources of protein and energy,to meet the increasing demand of food which is laging behind supply.

Novel sources should meet several criteria before being incorporated into human or animal feeds. One of the most attractive novel protein sources is that derived from the fractionation of the green crops. Green crops and mainly fodders are used for feeding ruminants, although, its protein content is not used efficiently. Therefore, the process of producing leaf protein concentrates from green crops is considered of special importance for the optimization of the use of these crops.

The produced leaf protein could be used for monogastrics (See El-Alily and Soliman, 1979) while the pulp could be used for ruminants. Clover (Trifolium alexandrinum) comprised the major feed ingredient to our livestock. It is grown in winter season and furnishes on average 4 million tons of starch equivalent and 976000 tons of

digestible protein . It was estimated that the total requirements of protein for local livestock accounts to 1263528 tons anually (Ali & Badawy, 1976 and El-Alily & Soliman, 1979).

The present study was therefore carried out to determine whether fractionation of the green fodder (clover) can improve its use as an animal feed or not. This was examined through the production of both dried clover leaf protein concentrate and pulp, followed by determining their nutritive values for suckling lambs and mature sheep.

REVIEW OF LITERATURE

1. Green fodder fractionation :

The fractionation of green crops is theoretically attractive because although high yields per feddan of crude protein and dry matter can be obtained from these crops their crude protein is often used inefficiently by ruminant animals. It is however possible to mechanically extract protein from grass crops in a form which can be used efficiently by non-ruminants and which can be further processed for use in human food. The remaining pressed crop (pulp) can be fed to ruminants. The possible import saving from green crop fractionation is large. It is calculated that the extraction of 25 % of the crude protein from only 14 % of the present lowland grazings would supply as much crude protein as that currently imported for feeding pigs and poultry (Jones 1976).

Pirie (1971) summarised the position with regard to research progress on green fodder fractionation as follows : By 1939 , therefore, the position had been fully defined, the quantity and extractability of protein in a few leaves was known, the advantages of extracting

it were recognised, some methods for doing this were known, and so were the bulk properties of the proteins. All that remaind was to find out whether the production of leaf protein in bulk was practicable and whether the protein would prove to be nutritionally valuable. The work of Byers and Sturrock (1965) , provided details about the composition and extractability of the protein of many more leaves. Also the work of Duckworth and Woodham (1961) , and Woodham (1965), indicated that the potential value of the extracted protein ranks in biological value among the highest of all known proteins.

Houseman and Connell (1976) found that the mechanical fractionation of green crops provide means of extracting larger quantities of protein for utilization by non-ruminants, leaving a pulp suitable for ruminants.

2. Leaf protein concentrates as a source of protein:

The recent technological advance have made it possible to separate the protein component of the green leaf from the other accompanying nutrients produced during the photosynthesis process. Separation of protein in the form of leaf protein concentrate facilitates its

use in feeding both ruminants and non-ruminants, (Free and Satterlee, 1975).

Duckworth and Woodham (1961) tested leaf protein concentrates (LPC) as a source of supplementary protein in diets for growing chicks and rats. Products made from mixed grasses, were all of high nutritive value, being nearly similar to soya-bean meal as protein source.

The work of Pirie (1942) and Arkcoll and Davys (1971) on the commercial fractionation of leaves showed that the protein fraction contained 50 - 60 % protein, unsaturated fatty acids, pigments, vitamins and minerals.

The fibrous residue can be used for feeding ruminant animals and the whey or liquid residue from protein precipitation is potentialy useful fermentation medium,(Pirie, 1971) that may be suitable for silage making.

Hancrakowski (1977) used standard methods for preparing leaf protein concentrates from lucerne, red clover, beet leaves, potato haulm, rape, vetch, grass and kale. The yield of protein from all plants exceeded 40 % except that from rape which was only 14 % . The average protein

content of LPC was ranging from 16.4 % for rape to 64.1 % for vetch.

Studies on berseem, showed that the yields of fresh fodder and extractable protein were affacted by the frequency of cuting and exceeded 700 quintals/ha and 660 kg/ha, respectively. From 40 to 45 % of fresh matter remained as pulp after fractionation. The process reduced the moisture and protein contents of the fiberious pulp to a level where it can be immediately ensiled. Even after two extractions, the pulp had 11.5 to 16.5 % protein on dry matter basis (Mungikar et al ., 1976).

3. Preparation of leaf protein concentrates :

Making concentrates high in protein and low in fiber from green leaves has long been known and various systems for preparing protein concentrates have been developed. Generally, fresh plants are pulped and the juice, carrying much of the protein with it, is separated from fibers. The process of producing proteins from different plant leaves could be achieved in four stages: extraction, coagulation, filteration and drying.

3.1. Extraction :

The extraction of the juice carrying the protein from green crops consists of pulping with addition of water or alkali, if necessary , using machinary of different designs. Morrison and Pirie (1961) stated that although extraction machines may differ in many aspects but they are based on the same notion.

The design of machinary can affect the efficiency of extraction. The action of the machinary depends on efficient maceration of the crop to rupture the cell followed by squeezing to separate the juice from the pressed material (Koegel and Bruhn, 1977 and Shepperson et al ., 1977) . However, conflecting results concerning the optimal conditions of mechanical processing was obtained by Houseman and Conell (1976) . They showed that the machine efficiency is significantly affected by crop species, stage of maturity and intensity of juice extraction.

With high-quality crops half the protein appear in the first extract. To increase the extractability of plant protein, an amount of water similar to the amount

of juice already extracted was added and half of the remaining protein was extracted (Shepperson et al ., 1977) . They also stated that it is seldom worth while extracting for a third time. Moreover , it was found that although the water added during the extraction increased the extractability but it was found to be undisirable because of the low concentration of nutrients in the liquid.

The protein extraction ratio (PExR) depend upon the crop, its age and growing conditions.Many workers (Byers, 1961 ; Lexander et al ., 1970 & Carlsson, 1975) have carried out screening trials which have shown considerable variations between crops in the efficiency with which protein can be extracted. In many cases some of these variations resulted from expressing the protein extracted as a percentage of CP in the whole crop, thus making no allowance for the variable content of non-protein-nitrogen.

As the crops mature, the percentage extraction diminishes and by the time a leaf is begining to turn yellow and becomes hursh to touch, only 15 - 20 % of its protein will be extractable even if water and alkali are added (Pirie, 1971).

The work of Byers and Sturrock (1965) and Arkcoll and Festenstein (1971) has been carried out with a view to extract protein from a sequence of annual forage crops. On account of the low dry matter percentage of annual forage crops they are particularly attractive where a high PExR is desired .However, it is unlikely that these annual crops will from the basis of a crop production system on account of the management risks involved in establishing an even flow of crop to the processing factory and because of the reported high establishment costs (Heath, 1977) . Crop production systems will most likely be based on perennial forage crops such as grass and lucerne, from which it may be possible to achieve a high PExR by the addition of water.

Arkcoll and Festentein (1971) , indicated that continual advances in the understanding of the factors affecting the extraction rate have led to modifications in the machinery and agronomy so that plant species proviously rejected are now being reconsidered. Moreover, the extraction rat has nearly doubled.

The studies of Betschart and Kinsella's (1973), have developed several laboratory-scale extraction