THE USE OF ULTRAFILTRATION TECHNIQUE TO REDUCE THE ENVIRONMENTAL POLLUTION CAUSED BY THE DAIRY INDUSTRIES

BY

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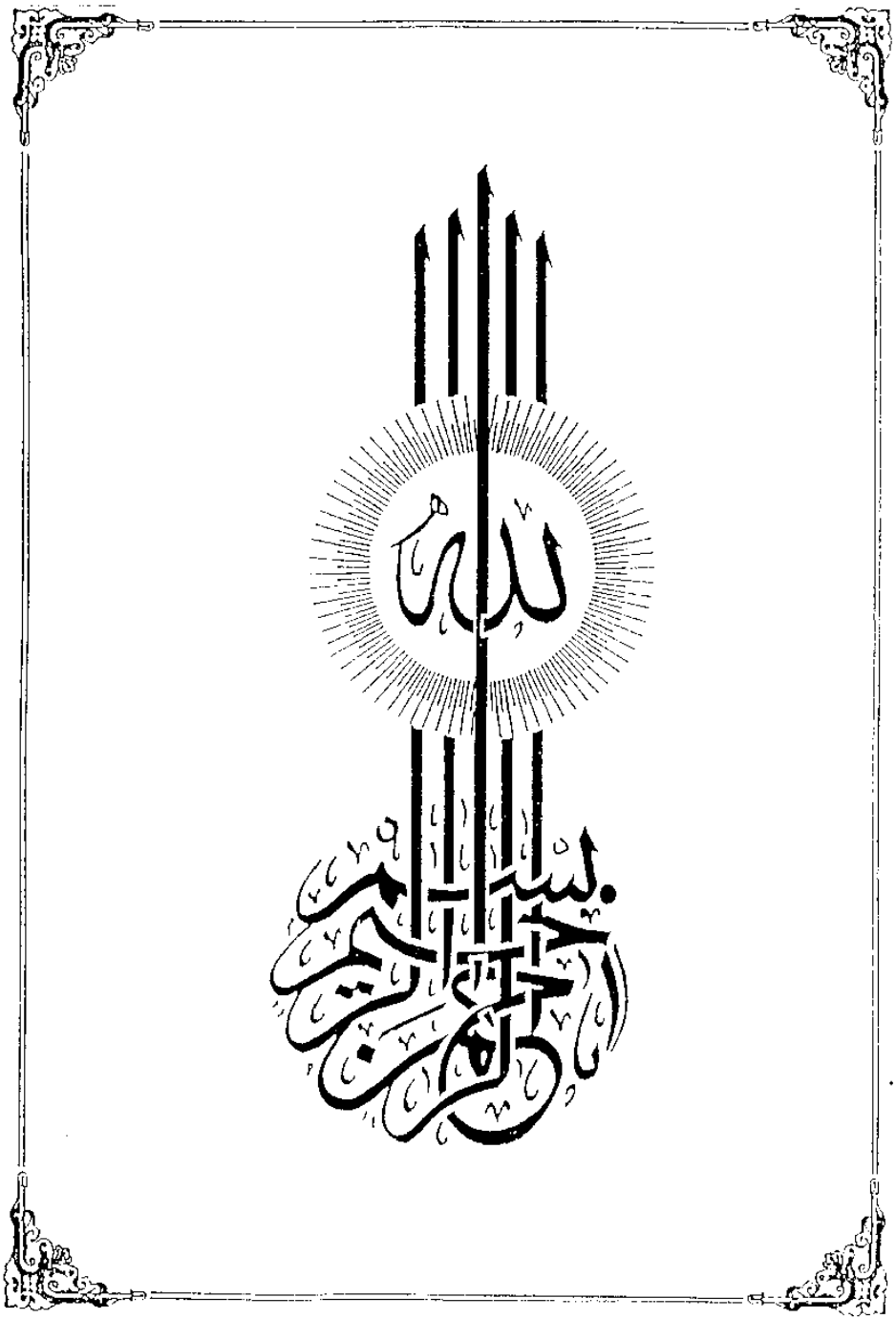

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INTRODUCTION

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The presistent need to overcome the great problem related to the environmental pollution, is one of the recent terrestrial objectives, specially with the continuous increase in the disposable effluents of many industries. In dairy industry, such effluents are characterized by large volume, high organic materials, irregular composition and presence of caustic and or acid fluids. Waste effluents of milk processing plants consist of rins water from milk storage tanks and processing equipment, as well as the cheese whey.

All dairy plants in Egypt discharge large amounts of waste effluents to the main drainage without any treatment, which cause serious problems due to the biological effects. The organic matters are excellent substrates for microbial growth, consequently deoxygenation of the water would led to suffocate many living beings, followed by putrefaction.

Membrane ultrafiltration (UF) is an effective process for the separation of various organic compounds and colloidal particulates present in aqueous solution and has been used for the treatment of a large number of industrial fluid wastes.

The use of UF in the dairy industry has expanded in many countries, and it is estimated that at present about 7-8% of the world output of whey is subjected to ultrafiltration, producing whey protein concentrate (UF-WPC) and permeate. The UF-WPC was found to be more suitable than the other proteins in nutrition, providing the body with essential amino acids. However, the UF-permeate consists of water, lactose, salts, vitamins and low molecular weight nitrogen compounds.

The present work is an attempt to reduce the pollution load from dairy wastes by using UF-technique and utilization of the resulting UF-WPC (retentate) and permeate. The study was carried out through the following parts:

PART I: Effect of ultrafiltration technqiue on microbial load and chemical characteristics of disposalbe effluents of dairy plants.

PART II: The use of whey protein concentrate for Kariesh cheese production.

PART III: Utilization of whey and permeate as media for mushroom propagation.

REVIEW OF LITERATURE

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Cheese whey as a pollution source:

Anderson (1970) found that the nature and diversity of the problems confronting the cheese industry, as far as whey is concerned, are impressive. For each pound of cheese, approximately 9 pounds of liquid whey are drained, containing about 7% solids. These solids contain 4.9% lactose, 0.9% protein and 0.5% ash. Disposing whey into sewage streams or to sewage treatment plants lead to many problems because of its high biological oxygen demand(BOD). It has estimated that the BOD of 100 pounds of whey is equivalent to the BOD of wastes produced by 21 people every 24 hr. Such high BOD would mean that great reduction in the oxygen content of water streams, followed by serious deterioration for the aquatic life.

Janis et al (1972) mentioned that the 22-23 billion pounds of whey produced annually in USA by the cheese industry pose a substantial challenge to food and feed technologists, and are a major problem in pollution control. Although approximately one-third of the whey produced is utilized in food and feed formulations. New product development is required for greater utilization of this byproduct.

McCombs et al (1973) mentioned the dairy effluent treatment system at Bongards Creameries. 2 aerated ponds reduce the BOD effluent from 1700 mg/l to 500 mg/l, and 275 mg/l. respectively; final BOD effluent from the entire system is 55 mg/l.

Devibiss et al (1974) reported that the pollution and environmental control have led to greatly expanded efforts to develop new uses for cheese whey. On the premise that the whey constituents are individually more valuable than the parent raw material, new techniques for the isolation of whey protein from the lactose and salts have resulted in the production of high-protein concentrates.

Royal (1974) said that milk washings containing 1% of whole milk would have a BOD of about 1,200 mg/l and whey is consider the main sources of milk solids in the effluent because is an excellent source of protein and lactose. The deoxygenating effect of waste water containing milk, milk products, and by-products on a river or stream was conveniently assessed by determining BOD. Therefore, a knowledge of the BOD enables an estimate to be made of the polluting character of the waste liquid. He added that the BOD of skim milk, whey and cheese pressing(Cheddar)

were 72,000; 44,000 and 130,000 mg/l respectively.

Wheatland (1974) reported that the organic matter in the wastewater from dairies forms an excellent substrate for growth of micro-organisms, and if allowed to enter a stream results in growth of bacteria, often seen as filamentous "sewage fungus" and leads to deoxygenation of the water. He added that, if the amounts discharged were significant, fish would be suffocated and malodorous putrefying deposits formed. Therefore, he recommended a process for treatment of settled dairy waste water to produce an effluent of good quality suitable for discharge to a stream. This process was applied in a alternation double filtration with recirculation of final effluent to reduce the biochemical oxygen demand (BOD) of the liquid to be treated to 300 mg/l. He also reported that reverse osmosis and related membrane filtration processes are of potential value in separating protein and lactose from dairy by-products such as whey.

Levin and Samuelsson (1975) studied the milk-water mixture resulting from rinsing of equipment in Swedish dairies which was often discharged as effluent and its possible re-use (e.g. as dried milk for animal feeding)by using the reverse osmosis a DDS laboratory module (with membrane

870) to concentrate the milk-water to 18% TS before evaporation.

Magnusson (1975) studied the polluting effect of different dairy products (e.g. whipping cream and 60% whey concentrate both have a BOD_5 of 400,000 mg/l, a BOD_7 of 450,000 mg/l and the BOD_7 of dairy effluent normally ranges from 500 to 4000 mg/l. Examples are given of the quantity of effluent and pollutants arising in various processes(milk reception, pasteurization, market milk packaging, buttermaking, cheesemaking and production of dried and concentrated products.

Strom (1975) enumerated the sources of waterborne milk particles in dairy effluent(cleaning of tanks and equipment, separator sludge) and factors affecting the quantity and composition of effluent (products made,equipment and processes, etc.), the methods of measuring the quantity and its pollution load (BOD_5, COD, total organic and pH) were determined. He points out that COD analysis is probably the most suitable method for routine monitoring of dairy effluent, since results are obtained within about 2 h and 7 days for BOD.

Ziglio et al (1975) examined the waste waters from market milk and butter making factories. Their chemical