UTILIZATION OF DAIRY BY PRODUCTS IN THE MANUFACTURE OF SOME TYPES OF SOFT CHEESE

By

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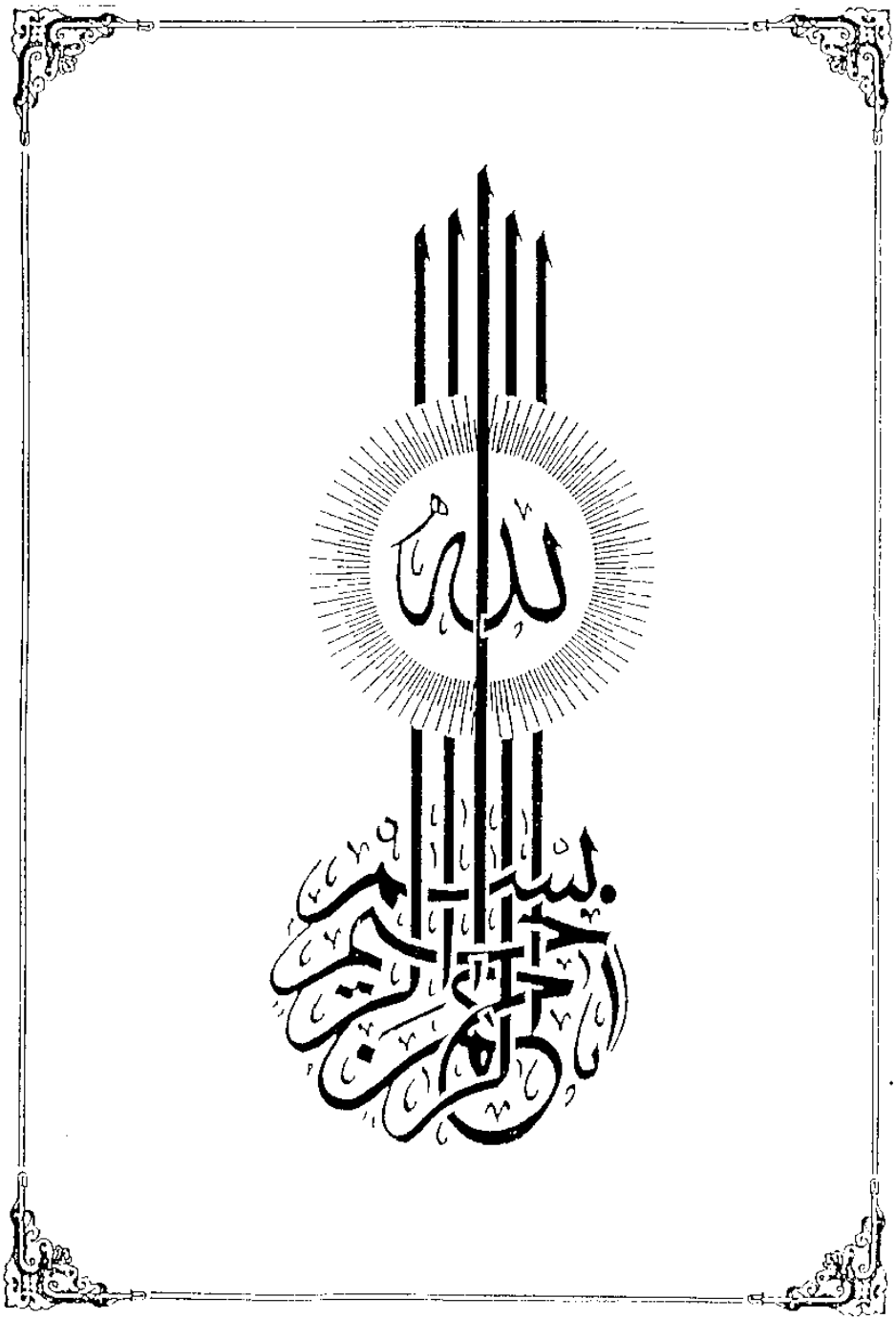

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CONTENTS

INTRODUCTION

Skim milk, buttermilk, and whey are the by-products of the dairy industry, remaining after separation of cream, churning of butter and the manufacture of cheese or casein.

It is difficult to find out the exact quantities of milk utilised for different manufactering purposes in Egypt.

Approximately, 50 per cent of milk supply is utilized for making butter and Samna, 40 per cent for cheese making and 10 per cent for fermented products and liquid milk.

In many countries milk by-products are simply used for animal feeding in the form of fluid skim milk, or in many cases thrown away. Great efforts and attempts have been devoted to widen the fields of utilizing skim milk and buttermilk as a component in various food-stuffs and fodder. Intensive researchs have been, and being applied for improving the quality and for reducing production costs.

In fact skim milk and buttermilk are no longer regarded as by-products in modern dairy plants. As to whey, however, many problems still remain unsolved.

In some countries much of it is spray dried. In Denmark they solve the problem by returning the whey (after separating its fat) to the farm for feeding purposes.

Considering the increasing demand for food, whey is still a challenge to food technologists. The relatively low total solids content, only about 6% and a low ratio between protein and lactose, 14/70 resulted a

higher drying cost and rather low nutritive value. Another important factor is the great variation in types of whey produced, which makes it difficult to establish a standard and constant product

The main sources for whey are : cheese making and manufacture of casein. The numerous types of cheese and the methods used for precipitating casein resulted great variations in the composition of whey. Normally, much whey deteriorates during storage and transportation, because it is considered an inferior by-product not worth pasteurizing nor cooling. The manufacture of lactalbumin has never been a profitable operation, as the yield is very small and markets for this product are quite limited.

In most cases, manufacturers of lactose have been content to market lactalbumin produced in their operations on a basis of cost and at times have been obliged to apply part of its manufacturing costs against the cost of lactose manufacture. Whey protein can be coagulated and used for making a cheese such as Ricotta, but since the proportion of whey protein to total whey solids is low, the yield of cheese is relatively small.

In the Egyptian dairy industry cheese-making may be considered one of the most important items. The popular types of cheese in Egypt belong to the soft varieties, and in particular "Domiati" cheese. To this latter cheese, salt is added to the milk before renneting usually (5 to 15 per cent salt). It has been proven suitable for the conditions of milk production and manufacturing in Egypt besides the possibility of

preservation in pickled form.

The large amount of salted whey remaining in cheese factories, causes much trouble because of disposal difficulties.

This study aimed to increase utilization of whey as food for human nutrition, by producing a cheap palatable food made wholly or in part from whey. This would help in solving the problem of mal nutrition in developing countries due to deficiency in proteins. Moreover it would help in reducing the cost of cheese production, which is relatively high in the Arab Republic of Egypt. Therefore an investigation on production of a cheap and palatable cheese of high nutritional value from whey or whey and skim milk powder would be of great value.

PART I

CHEMICAL COMPOSITION OF WHEY PRODUCED FROM DIFFERENT TYPE OF CHEESE

CHEMICAL COMPOSITION OF WHEY PRODUCED FROM DIFFERENT TYPES OF CHEESE

Review of Literature

The term "whey" used without qualification always refers to the bulk liquid run from the vat at "whey off" step.

It is recognised that in cheese making, a portion of milk nutrients is lost in whey. These unretained nutrients consist mostly of lactose, albumin and globulin, as well as, minerals and water soluble vitamins in varied proportion.

While the amount of these constituents lost in whey is considerable, the retention efficiencies for fat, casein and other minerals are relatively high.

In A.R.E. two main types of cheese are manufactured on large scale, white soft cheese "Domiati" and hard cheese or semi soft one. The salted whey remaining from the first type contains about 15 to 23 per cent total solids, depending upon its salt content.

The unsalted whey, which is the by-product of hard cheese or semi soft cheese contains about 7 per cent total solids.

When milk is converted into cheese nearly all the fat and casein are retained in the curd but small proportions are lost in the whey. Whey varies considerally in composition according to the composition of the original milk, to the cheese-making process, and to the skillness and technique of the cheese maker.

Van Slyke, (1894), showed that the dry matter of cheddar cheese whey averaged, 6.96% total solids consisting of :

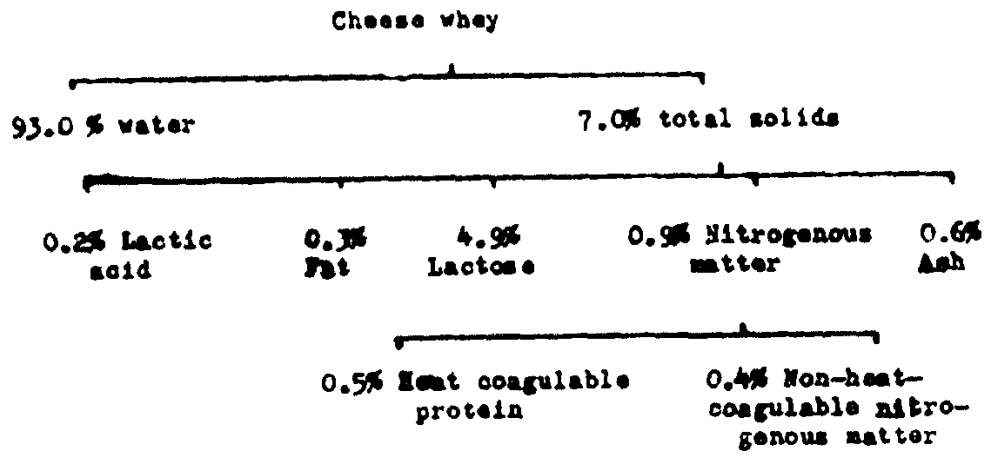
0.36% fat, 0.84% protein, 5.76% lactose and salts.

Webb and Whittier, (1948), in reviewing the utilization of whey, stated that typical cheese whey can be expected to contain 6.9% total solids consisting of :

0.3% fat, 0.9% protein material, 4.9% lactose, 0.6% ash and 0.2% lactic acid. They reported that these values are variable because the composition of milk and cheese making procedures are not constant.

Whittier and Webb, (1950), stated that differences found in the composition of wheys are attributable mainly to the method used in the coagulation of the casein, and to the extent to which fermentation of the lactose has been allowed to progress.

When the coagulation agent is rennet, the calcium and phosphorus of the casein complex remain for the most part with the curd. The ash content of the whey is therefore less than it is when the coagulating agent is acid, which transfers part of the phosphorus and most of the calcium to the whey. Some fermentation is a requisite part of most processes of cheese making, the main product being lactic acid, which is formed gram-per-gram from the lactose. Lactic acid is formed in greater quantity in the making of self sour casein. They stated that whey consist of :



They also mentioned that the formation of gases and volatile acids by fermentation reduce the lactose percentage and, in such instances, the increase in acidity, calculated as lactic acid, is not equivalent to the decrease in lactose.

Normally, the acidity of whey in "Domiati" cheese is lower than the acidity in hard cheese (Sharara, 1947 and Hamed, 1955) due to salting the former before renneting.

Salt has a checking effect on bacterial activity which causes the raise in acidity. In addition, buffaloes' milk is usually used in "Domiati" cheese making, which has a higher buffering capacity and slower acid development than cows' milk (Sharara, 1947, Fahmi and Sharara, 1950 and Rifaat, et al., 1965).

Adding starter to hard cheese contributes to most of the acidity found in whey.

Nowlander and Atherton (1964), stated that as chloride increases, the acid percentage decreases and vice versa.

Sharara, (1957), found that whey drained from "Domiati" cheese salted at the rate of 10% has an average acidity of 0.04%.

Sirry and El-Rakshy, (1954), however, gave an average acidity of 0.212% from their work on "Danni" cheese while Fahmi (1950), reported an average of 0.48% in fresh whey sample produced from manufacturing "Kareish" cheese.

Addition of increased amount of salt to milk was accompanied by a decrease in the acidity developed in whey. This is apparently due to the inhibitory action of salt on the lactic acid bacteria. Such a retarding effect has been reported by numerous investigators.

McDowall and Whelan's experiments, (1933), showed that while the addition of 1% always and 2% frequently stimulated the growth of lactic acid bacteria, 3% usually and 5% salt regularly inhibited their action, total inhibition was approached at any concentration greater than 6%.

Sharara, (1957), stated that the calcium percentage increased in the whey drained from the rennet curd of salted milk, by increasing the amount of salt added. The explanation of this observation was based on the replacement of calcium by sodium ions forming sodium caseinate or sodium calcium caseinate and calcium chloride. He found that the maximum percentage of calcium in whey was reached by the addition 7.5 g.

of NaCl/100 g. of milk. When more NaCl was added a depression in the percentage of calcium in whey was noted.

Leigner, (1950), showed in the Hofmeister lyotropic series, that (Na) can replace (Ca) ion owing to its replacing power. Also Schachtschnabel, results (1950), showed that in cations of different replacing powers and different valences, for example Na^{+} vs Ca^{++} dilution produced marked effect on exchange.

Gedroiz results, suggest that the replacing effect of (Na) ions falls as the concentration of the solution decreases, and with extremely dilute solution very little Na^{+} will be taken up through exchange for Ca^{++}. This may explain the increase of percentage of soluble calcium in whey by increasing the percentage of NaCl added to milk.

Kelley and Cummins (1950), findings are in harmony with those of above mentioned studies.

Bosworth, (1916), recorded the reaction taking place in milk by the addition of NaCl as follows :

$$\text{Ca caseinate} + \text{NaCl} \rightleftharpoons \text{Na or Na-Ca caseinate} + CaCl_2.$$

As proposed by Van Slyke, (1926), the reaction expressed as follows :

$$\text{Ca} \begin{matrix} \nearrow \\ \searrow \end{matrix} \begin{matrix} \text{Caseinate} \\ \text{Caseinate} \end{matrix} + 2\text{NaCl} \rightleftharpoons 2\text{Na caseinate} + CaCl_2$$

Caseinate → Insoluble

2Na caseinate → Soluble