STUDIES ON CULTIVATION AND PRESERVATION OF STARTERS

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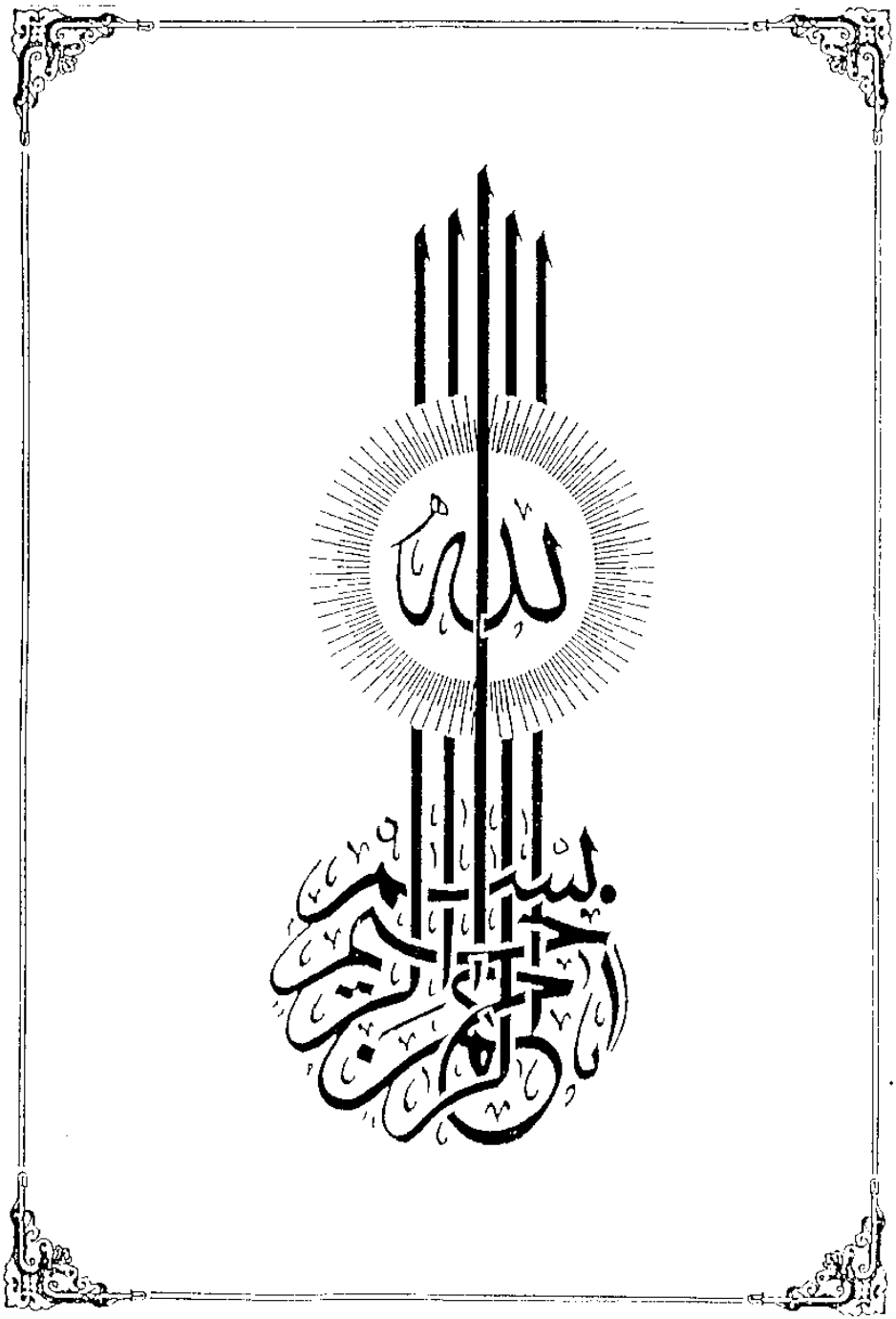

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I N T R O D U C T I O N

INTRODUCTION

Starter is the common name for a culture of desirable organisms used in making cheese, or other dairy products. There are many different kinds of starters. The starter that produce acid at a rapid rate is the most important and widely used. Such starter is commonly known as "lactic starter" and may be defined as a milk culture of one or more lactic streptococci, usually str.lactic and/or str. cremoris.

These types or species of souring bacteria usually constitute the main flora of naturally soured milk which convert about 1% of the lactose in milk almost entirely to lactic acid, with small quantities of other products such as acetic acid and carbon dioxide, and normally with no substances causing taints.

Historically, the use of lactic starter cultures is an old practice in the dairy industry. Lactic starters are essential in cheese-making and in cultured dairy products manufacturing. It is well established that th length of time needed for processing such products is greatly dependant upon the rate of acid production by the starter. In addition, the quality of the finished products depends to a certain degree upon the starter activity.

In Practice, as a means of facilitating propagation of lactic starters, various types of storage and preservation have been established. Preservation of lactic starters without losing normal activity would be of economic and technical importance. From technical stand point, the common practice of daily transfer of cultures would be eliminated.

In addition, the possibility of contamination would be greatly reduced. The economic point of view, savings in time, equipment, materials and the media could also be attained. Morever, It is very important to maintain the activity of the starter at a normal level during storage and preservation.

Strains of streptococci may change in their rate of souring. The factors responsible for such variation may be many and are usually impossible to control or predict these changes. The only practicable solution, beside constant checking and discarding of unsatisfactory cultures, is to control and uniform the conditions under which the starters are cultivated. Conditions of cultivation include the type of growth media, treatments given to this media, and temperature and time of incubation. Variations in cultivation conditions may

cause the starters to grow irregularly and produce acid at in consistent rate. Also, heat treatments of the growth media, mainly milk, may show stimulatory or inhibitory properties for culture organisms depending on the treatment.

In addition, the growth temperature is the predominating factor in a given medium.

The time and temperature of incubation are inversely related factors. Further more, methods used in the preservation of lactic starter cultures have involved low-temperatures storage, freezing and freeze-drying under various conditions and with various protective additives to maintain starter activity. Afreshly liquid culture may be frozen and then held for several months with only minor loss in vitality.

Although the freezing process kills some of the cells as reported by many workers (Johns and Kawashima), it is usual to recover at least 75 to 90% of the viable bacteria in lactic cultures after freezing and thawing. This procedure is recomended for those who wish to keep a culture on hand for emergency use or to maintain usefulness of the culture as an inoculum for a long period with out having to make daily transfers.

Freeze-drying or lyophilization is said to be a method of preserving bacterial cultures for years without loss of their characteristics.

This process is widely applied in the preservation of stock cultures and it has been employed for years is the distribution of dairy organisms.

They usually develop almost normally on the first transfer, and thus they are avaible for use quickly.

However, such cultures may cost slightly more than those prepared by other means.

Lactic starter cultures can also be dried successfully by spray drying. Such preparations remain viable for such longer periods of time than liquid cultures, thus they may be shipped further and held longer particularly under refrigeration. They have the disadvantage that several transfers frequently are required before culture returnes to normal. However, attempts to spray-dry ordinary milk cultures of lactic acid bacteria have not been very encouraging. Butter and cheese-makers judge their starters by taste, rate of acid development, smell and appearance. Mixed-strain starters may remain active and preserve their characteristics for some time, but

may lose their activity rapidly according to the comparability of their species and strains. Single and mixed-strain starters of str. lactis and str. cremoris are especially used for the manufacture of Cheddar cheese and a wide variety of fermented dairy products.

Several factors are concerned in the successful propagation of starters. Some of these factors are, the composition and type of milk (Cow's or buffaloe's), heat-treatments of the milk; conditions of propagation, storage and maintenance of cultures and the presence of inhibitory substances and finally the role of phage.

With this in view, the present work was planned to study:

1. The effect of some cultivation conditions on the viability and acid production of single and mixed-strain starters of lactic streptococci cultures.

The cultivation conditions studied involved the following:

* Incubation temperature.
* The effect of various heat-treatments on the suitability of milk as a medium for starter bacteria.
* Type of milk used as a growth medium.

II. The effect of some methods of preservation, mainly freezing and freeze-drying (lyophilization) on the viability and activity of the same lactic streptococci cultures, cultivated under the best conditions which will be concluded from the first part of this work.

PART I

THE EFFECT OF SOME CULTIVATION CONDITION ON THE VIABILITY AND ACID PRODUCTION OF LACTIC STREPTOCOCCI CULTURES

REVIEW OF LITERATURE

Effect of Incubation Temperature on Starter Cultivation

All bacterial cultures pass through a lag phase, a log arithmic growth phase and then slowly die out.

The predominating factor in a given medium, e.g. milk, is normally temperature. Usually the optimum growth temperature gives the shartest lag phase, the steepest log arthmic growth phase, and the fastest dying out phase. In other words the higher the temperature (over the growth range) the sooner does the culture become stable and die out. As the object of good starter production is to added the starter to the cheese milk in its most active condition, both temperature and age of culture are thus of over whelming importance van slyke and price (1952). The incubation temperature determines the rate of acid development, activity uniformity and quality in terms of flavour and physical characteristics. Investigation by Wolk and Tittsler (1958) showed that acid production by 9 strains of *str. lactis* and 14 strains of *str. cremoris* was greatest at 94°F (34.4°C) and largely lowered at 100 and 105°F (37.8 and 40.6°C).

Some variation between strains was noticed.

Foster *et al.* (1958) and Davis (1965).

Pointed out that str.lactis has an optimum growth temperature of 30°C (86°F) and a range of 10°C to 40°C (50°F to 104°F). Besides, Davis (1965) reported that the growth temperature of str. cremoris ranged from 10-36°C. However, it is well known that str.cremoris has many properties incommon with str.lactis.

A further most important effect is that in any mixed culture, the temperature permits one or more types to predominate. Therefore, mixed cultures should be incubated at a proper temperature which will maintain the desirable balance between the organisms in the mixed culture.

It was pointed out by Foster et al. (1958) that the usual incubation temperature for at which a mixed culture is incubated is 22.2°C (72°F) or a few degrees above.

Davis (1965) stated that a temperature of about 22°C is used for the common str.lactis plus str.cremoris type of starter.

Pette (1948) found that changes in incubation temperature within the range of 18 to 21°C had no effect on the stability of butter starters.