THE EXAMINATION OF MILK FOR PUBLIC HEALTH PURPOSES

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649317059

The examination of milk for public health purposes by Joseph Race

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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Trieste

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FOR

PUBLIC HEALTH PURPOSES

JOSEPH RACE, F.I.C.

City Bacteriologist and Food Examiner, Ottawa; Chairman of Committee on Standard Methods of Analysis, Canadian Public Health Association, Member of Committee on Municipal Food Administration, American Public Health Association

FIRST EDITION

NEW YORK

JOHN WILEY & SONS, INC.

LONDON: CHAPMAN & HALL, LIMITED

1918

PREFACE

THIS volume is primarily intended as a practical handbook for those engaged in the chemical and bacteriological examination of milk for public health purposes, but it is also hoped that it will be of material assistance to students and others who have previously assimilated the fundamentals of bacteriological technique.

The control of milk supplies was formerly confined to a chemical examination for adulteration, but since the beginning of the 20th century the bacteriological examination has been regarded as a "sine qua non," and in America the present tendency is to have both examinations made under the supervision of the Public Health Authorities. For this reason no apology is necessary for the inclusion of chemical methods and the data which will enable the examiner to interpret the results obtained.

In the bacteriological section an attempt has been made to include all methods that have been proved to be reliable and in some instances the details of the standard methods of the American Public Health Association have been given; in other cases the report as published by the A.P.H.A. should be consulted.

The tables of bacteriological results have been added in the hope that they will lead to the standardisation of records. At present the results reported by many laboratories are not comparable because of the form in which they are issued.

JOSEPH RACE.

OTTAWA, ONT.,
December, 1917.

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CHAPTER I

CONSTITUENTS OF MILK

MILK is the opaque white fluid which is secreted by the mammary glands. It consists essentially of an emulsion of fat and a colloidal solution of caseinogen in water containing lactose and traces of mineral matter.

Milk fat, with which is associated small quantities of cholesterol, lecithin, and a trace of colouring matter, consists of a mixture of triglycerides of various fatty acids. These acids are mixtures of the straight chain series $C_nH_{2n+1}COOH$ and $C_nH_{2n-1}COOH$, the less saturated acids being, according to the best information, entirely absent. The relative proportions of the various acids are by no means constant, being dependent upon various factors such as foodstuffs, seasonal variations, breed of cattle, and climatic conditions.

The fat is present in milk as enormous numbers of very small globules and it is the reflection of light from these particles and those of caseinogen that produces the characteristic white opaque appearance of milk. Although it was formerly held that the fat globules were surrounded by albuminous membranes which preserved the form, it is now generally accepted that this is due to surface tension and that the size of the globules can be altered by physical methods.

The size of the fat globules in milk varies from 0.8μ to 20μ with an average of about 2.7μ and the number of globules from 19×10^8 to 60×10^8 per cubic centimeter. Although no definite relation has been established between the breed of cattle and the size and number of globules there are a number of results which indicate that during interrupted milking the size of the globules increases with the fat content and also that as the lactation period proceeds the globules decrease in size and increase in number (see p. 43).

The origin and method of formation of milk fat have not been discovered although many hypotheses have been proposed. The normal process seems to be the formation of milk fat, directly or indirectly, from nutritive fat, but when this source is eliminated the formation of milk fat proceeds, though diminished in activity, by drawing upon the body fat. Even when the body fat is exhausted, milk fat can be formed: this is attributed to proteids acting as the source of fat.

The various analytical and physical constants of milk fat are:

Specific gravity $\frac{37.8}{37.8}$	0.9094–0.9140
Refractive index, 35° C	1.4550–1.4586
Melting-point	28° C.–36° C.
Solidifying point	21° C.–27° C.
Reichert-Wollny value	25–27
Iodine absorption	31–35

The calorific value of butter fat, according to Stohmann, is 9.231 calories per gram and according to Atwater, from 9.320 to 9.362 calories. A value of 9.3 is usually employed in calculating the calorific value of milk fat. The molecular weight of fat, as calculated from the amount of alkali required for saponification and assuming that all the acids present are monobasic, is from 720–740, whilst the direct determination by the cryoscopic method points to values from 696–716. The presence of dibasic acids would harmonise these two sets of results, but such acids have not been isolated from butter fat.

Lactose. Although there is some evidence of the presence of traces of a monosaccharide in milk, the carbohydrate secreted