expand it inevitably will. It is said that opportunity knocks but once at the door, but this is the opportunity of receivers, not of givers. To the latter there is no limit. If this building had been built and equipped five years ago, we might not have had to share with our great scientific rival on the continent the discovery of many capital facts concerning the X-ray, for it was only the lack of equipment which kept the brilliant group of physicists who, under the leadership of Professor Duane, have made so many important advances in the theoretical study of X-rays, from covering many of the practical phases developed instead by our continental colleagues. The verification of the quantum relationship between the frequency of the X-ray and the voltage applied to the tube, as demonstrated by Duane, Hull and Webster, is a shining achievement which might easily satisfy any university for a long period of time. The work of Tyzzer on animal tumors especially laid the foundation for much recent research, while the demonstration by Bovie of the relationship between certain light rays and the coagulation of protein and the killing of cells is also a most important contribution to the newer aspects of biophysics. Whether the problem of cancer—that last great and as yet unanswered question in medicine—will be solved here, no one can say. But I am sure that the attack will be a brave one and that the results will be characterized by the same scientific caution and freedom from attempt at dramatic effect that have marked the work of the Harvard Cancer Commission in the past. We all look to this laboratory as the source of the highest type of scientific investigation combined with an unusual amount of common sense on the human side, due obviously to the influence of the director, Dr. Greenough. There is no reason to think that with the passing of time there will be any change in this high standard.

Let us all hope then that this building and its equipment and staff represent merely a beginning from which research will go forward on a broader and broader scale, until at some future time we may have a better insight than at present into what has hitherto successfully evaded human inquiry—the nature of life and growth. When that goal is achieved the solution of the cancer problem will be in sight.

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THE EFFECT OF THE NATURE OF THE DIET ON THE DIGESTIBILITY OF BUTTER

IT is estimated that in the United States about 18 pounds of dairy butter are consumed per capita yearly and of this amount the larger portion is used for table purposes. This indicates quite conclusively that in spite of the increasing variety of fats available for table and culinary purposes, dairy butter still remains one of the most popular and widely used edible fats. Formerly it was very generally believed that the principal if not the entire food value of butter was due to the energy which it supplied to the diet. The recent discovery that dairy butter contains a relatively large amount of vitamin A, which has been shown to be essential for an adequate diet, has served to further increase the popularity of this extensively used fat.

The very general use of butter for food purposes is no doubt responsible for the early and continued attention that has been given to a study of its nutritive value by physiological chemists and nutrition experts. Many digestion experiments have been carried on both in this country and in Europe to determine its digestibility, but since the experimental procedures of the different investigators were not uniform the results obtained do not permit of direct comparison. The lack of uniformity in experimental conditions is perhaps most noticeable in the wide variation of the nature of the basal ration used by the different investigators. However, this variation in the nature of the foods comprising the experimental diets permits to some extent a comparison of the effect

NOTE: Since dairy butter is a common constituent of nearly all diets the following résumé of digestion experiments, conducted by the author while employed as nutrition expert at the U. S. Dept. of Agri., is given to supply information concerning the effect of other food materials on the digestibility of butter.

of the nature of the diet on the digestibility of butter. Rubner, in a lengthy series of experiments, reports three different values for the digestibility of butter—for a simple diet of butter and potatoes[1] 96.3 per cent., for a diet of green beans and butter[2] 91.5 per cent., and for the latter diet with a larger portion of butter[3] 97.3 per cent.

Malfatti studied a diet of polenta (a porridge of Indian corn meal) and butter and found that butter was 97.7 per cent. digested.[4] Mayer determined the digestibility of butter[5] eaten as a part of a simple diet and reports 98 per cent. and 97 per cent. respectively as an average of three periods of three days each with a mature subject and a nine year old boy. Atwater conducted digestion experiments on a diet of fish and butter and found the butter[6] to be 91 per cent. digested. Huldgren and Landergren, who served as their own subjects, found the digestibility of butter,[7] eaten in conjunction with hard rye bread, was 95.4 per cent. Luhrig studied the digestibility of butter[8] served with a basal ration of meal, bread and vegetables and reports a digestibility of 96 per cent. for butter. Von Gerlach determined the digestibility of butter[9] when it was eaten with a basal ration of rice, zweiback and oatmeal and found it to be 97 per cent. digested. Since in the metabolism experiments noted above that are not uniform there are many factors, such as food, habits, occupations, and races of people employed as subjects, it is unwise to attempt to generalize to any extent on the effect of the nature of the diet on the digestibility of butter.

However, in view of the very general and wide spread use of dairy butter in conjunction with many kinds of food materials, it appears of interest to summarize briefly a number of digestion experiments in which butter has been included as a part of the experimental ration and which have been conducted under identical experimental conditions, as regards the type of subjects, the length of experimental period, and methods of chemical analysis. In many of the digestion experiments conducted by the writer to determine the digestibility of cereals, legumes, meats, vegetables and flours, butter has been employed as a source of fat for the experimental diet. The butter included in the experimental rations was uniform in that it was always obtained from the same source. Since the digestion experiments considered here were made during a period of four or five years, no attempt was made to use a single lot of butter for the entire series of experiments, but it is believed that this butter obtained from a single creamery and presumably from a constant source of milk supply was typical of the ordinary commercial butter purchased by the average consumer.

The table on p. 662 contains the data essential for the consideration of these experiments and the text which follows includes a discussion of the details of the different types of diets.

The first group of experiments referred to in the table, eight in which dairy butter was the food material studied, are discussed in detail in the initial paper[10] of a series which has appeared from time to time reporting the results of digestion experiments conducted to determine the digestibility of a large number of edible fats and oils. To secure data concerning the relative digestibility of edible fats and oils several digestion experiments with each of the fats studied were conducted under uniform conditions. The experimental ration consisted of commercial wheat biscuit, fruit, sugar, tea or coffee and a special cornstarch pudding or blancmange in which was incorporated the fat under consideration. In order to mask any noticeable flavor or odor of the fats studied, the blancmange was heavily flavored with caramel which gave a uniform characteristic caramel flavor and odor to all the

[1] *Ztschr. Biol.*, 15 (1879), No. 1, pp. 136-147.

[2] *Idem.*, 16 (1880), No. 1, p. 127.

[3] *Idem.*, 15 (1879), No. 1, pp. 174-176.

[4] Sitzber, K., *Akad. Wiss. (Vienna) Math. Naturw. Kl.*, 90 (1884), III, No. 5, pp. 328-335.

[5] *Landw. Vers. Stat.* 29 (1883), pp. 215-232.

[6] *Ztschr. Biol.*, 24 (1887), No. 1, p. 16.

[7] *Skand. Arch. Physiol.*, 2 (1890), No. 4-5, pp. 373-393.

[8] *Ztschr. Untersuch. Nahr. u. Genussmtl.*, 2 (1899), No. 6, pp. 484-506.

[9] *Ztschr, Phys. u. Diätet: Ther.* 12 (1908.9), No. 2, pp. 102-110.

[10] "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

SUMMARY OF DIGESTION EXPERIMENTS IN WHICH DAIRY BUTTER HAS BEEN INCLUDED IN A VARIETY OF EXPERIMENTAL DIETS

Number of experiments	Nature of food material studied	Amount of fat eaten per subject daily, grams	Per cent. of butter in total fat consumed	Digestibility of entire ration		
				Protein per cent.	Fat per cent.	Carbohydrate per cent.
8	Butter	100	98	70.5	97.0	96.4
10	Dasheen	127	99	80.8	96.1	97.6
7	Soy-bean press-cake	92	62	86.6	94.2	96.3
4	Peanut press-cake	117	46	90.4	96.5	97.2
3	Kafir	67	99	49.5	91.6	97.0
4	Feterita	59	94	49.9	92.3	98.2
4	Milo	72	88	36.3	92.1	97.5
5	Kaoliang	76	89	13.3	90.2	97.0
5	Fine wheat bran	134	67	52.6	94.6	82.7
6	Unground wheat bran	107	65	39.9	93.7	84.4
7	Hard Palates	127	78	87.3	94.6	97.6

experimental diets which included edible fats and oils. Eight tests were made with this type of diet to determine the digestibility of butter and it was found that on an average butter was 97 per cent. absorbed by the body.

The studies of the food value and culinary possibilities of the dasheen, a variety of the taro (*Colocasia esculenta*), which is a staple constituent of the diet in large areas of the tropical countries, included a number of digestion experiments.[11] Since the advisability of the introduction of the dasheen into the subtropical regions of the country where the white potato can not be successfully grown or stored was under consideration, it was of considerable importance to have data concerning its digestibility. The basal diet for the digestion experiments with dasheen consisted of milk, which supplied the larger portion of the protein of the diet, fruit, and butter, which, with the fat from the milk, supplied the fat of the diet. The carbohydrate portion of the diet was largely derived from the dasheen. The results of these experiments show butter to be 96 per cent. digested when eaten as a part of a diet in which the carbohydrates were largely starch, derived from a starchy vegetable.

During the World War when it became necessary to conserve all resources to the utmost, the writer became intensely interested in promoting the use of the soy-bean and peanut press-cakes for human food. The expression of oil, under sanitary conditions, by the "cold process" from sound, clean soy-beans or peanuts produces a virgin oil and a high grade press-cake rich in protein. These legume proteins glycinin (soy-bean) and arachin (peanut) yield on hydrolysis a large amount of lysine, the amino acid essential for growth. The reported results of the chemical and biological examination of soy-bean and peanut proteins demonstrate beyond a doubt their high nutritional value. In order to supplement this data with information concerning the digestibility of these proteins, digestion experiments[12] were conducted in which the soy-bean and peanut press-cake flour combined with wheat flours was served in the form of biscuits. The experimental diet consisted of biscuits, fruit, butter, sugar and tea or coffee. Butter was served as a spread for the biscuits and lard was used as "shortening" in their preparation, accordingly the values reported for digestibility apply to the total fat of the diet rather than to either individual fat, but as both butter[13] and lard[13] have been reported as being 97 per cent. digested, it is of interest to note the effect of the soy-bean and peanut flour diets on their digestibility. Since butter constituted a half or more of the total fat of the experimental diets and since the reported digestibility for the total fat of the diets was for the soy-bean experiments 94 per cent., and

[11] "The Digestibility of the Dasheen," *U. S. Dept. Agri. Bul.*, 612 (1917), pp. 11.

[12] "Digestibility of Protein Supplied by Soy-bean and Peanut Press-cake Flours," *U. S. Dept. Agri. Bul.*, 717 (1918), pp. 28.

[13] "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

for the peanut experiments 97 per cent., it is evident that the digestibility of butter was lowered little if any by the other constituents of this type of diet.

From the results of the many attempts that have been made to find cereals suited for cultivation in the semiarid regions of this country it appears that the so-called non-saccharine grain sorghums are best adapted for the purpose. While these cereals are extensively included in the dietary of India, China, Abyssinia and South Africa, there is little recorded data relative to their digestibility. Accordingly digestion experiments were made to secure information concerning their value for human nutrition. Of the many non-saccharine grain sorghums which may be grown in the semiarid regions four, Dwarf Kafir, Feterita, Milo and Kaoliang, were chosen as typical. To determine the effect of cooking, etc., upon digestibility, experiments with the non-saccharine sorghums prepared in a variety of forms have been made by the writer but for the discussion here only those in which the sorghums were cooked and served as a mush will be considered since in these diets butter constituted practically the entire fat content of the diet. In this type of digestion experiments[14] with the grain sorghums the diet consisted of the cereal cooked as mush, apple sauce, butter, sirup, sugar and tea or coffee if desired. As may be noted from the above table the results of the digestion experiments with the non-saccharine sorghums show that their proteins are very incompletely absorbed by the body, due probably to the proteins being inclosed in the very tough cellular structure of the cereal. This coarse, rough, cellulose also may increase peristalsis to such an extent that the diet passes more rapidly than normal through the alimentary tract. If this theory is tenable it may also explain the lowered digestibility of butter, which was for the kafir experiments 92 per cent., for those with feterita 92 per cent., for those with milo 92 per cent., and for those with kaoliang 90 per cent.

For a long time considerable attention has been given to the desirability of including or excluding wheat bran in milling wheat flours. Inasmuch as the annual per capita consumption of wheat[15] is approximately five bushels this question assumes considerable importance, and among the factors to be considered in arriving at an intelligent solution of the problem is the extent to which the bran is digested by the human body. To obtain data in this connection a number of digestion experiments were made with coarse unground wheat bran and bran which had been ground to resemble flour in fineness. In these experiments[16] the bran was incorporated in a gingerbread and served in conjunction with potato, fruit, butter, sugar, and tea or coffee. As in the soy-bean and peanut flour experiments, lard was used as "shortening" in preparing the gingerbread and butter was served as a spread for the bread. Hence the values reported for the digestibility of fat refer to total fat of the diet. However, since a large portion of the total fat consumed was butter and since in the fine wheat bran experiments the total fat was 95 per cent. digested and in the unground bran experiments it was 94 per cent. digested, it is evident that for practical dietetics this type of diet did not lower the digestibility of butter.

According to reports[17] the large packing houses use the "hard palates" of cattle, which are taken from the roof of the mouth of beef animals, in the manufacture of potted meats and sausage in amounts varying from 2,500 lbs. to 6,000 lbs. monthly. Since chemical analysis showed that hard palates contain approximately 20 per cent. of protein it was decided to determine to what extent this protein was digested by the human body and seven digestion experiments[18] were made in which the ration consisted of potato, crackers, butter,

[14] "Studies on the Digestibility of the Grain Sorghums," *U. S. Dept. Agri. Bul.*, 470 (1916), pp. 30.

[15] *U. S. Dept. Agri. Bur. Crop Estimates Rept.*, 3 (1917), No. 10, pp. 99.

[16] "Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour," *U. S. Dept. Agri. Bul.*, 751 (1919), pp. 20.

[17] "Digestibility of Certain Miscellaneous Animal Fats," *U. S. Dept. Agri. Bul.*, 613 (1919), p. 8.

[18] "Digestibility of Hard Palates of Cattle," *Jour. Agri. Research*, 6 (1916), No. 17, pp. 641-648.

sugar, tea or coffee and the hard palates served in the form of meat loaf. Butter was used in the preparation of the meat loaf and it was also served as a spread for the potatoes and crackers. From the results of the digestion experiments with the hard palate it was found that the total fat of the diet was 94.6 per cent. digested. Since the greater portion of the fat consumed was butter this figure is virtually that for the butter included in a protein rich diet—an average of 131 grams of protein was ingested daily by men employed at sedentary occupations. This should be sufficient indication that butter is very completely absorbed when eaten in conjunction with a high protein diet of this character.

SUMMARY

From the foregoing results of numerous digestion experiments it is evident that dairy butter is very completely utilized by the human body. In those diets in which the accessory foods were very nearly if not entirely absorbed by the human body, butter was found to be practically completed digested. When coarser materials, particularly those which provided considerable refuse, were included in the diet it was found that butter was somewhat less completely absorbed by the body. The general conclusion to be drawn from the results of the digestion experiments cited above is that butter eaten in conjunction with ordinary food materials is very completely digested and that for the diets studied, the nature of the diet does not produce a marked difference in the amount of butter absorbed by the human body.

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ARE SCIENTISTS ENCOURAGING POPULAR IGNORANCE?

I HEARTILY agree with the view of Mr. Halsey that readers of SCIENCE should become familiar with the anti-metric case as presented in the recent report of the National Industrial Conference Board, The Century Company, $2.00. This report gives the pro-metric argument as well as the anti-metric argument and is, therefore, signed by the metric members of the committee, but not as Mr. Halsey states, "because they could not do otherwise." Scientists do not need to be told the pro-metric argument, but they should know the character of the arguments advanced by the so-called American Institute of Weights and Measures against the metric system, Mr. Halsey being their paid commissioner. Beyond quoting them at length no comment of mine is necessary.

> For years . . . . the minds of children have been trained to believe in it (the metric system) as the only scientific system certain to become universal. Children leave school imbued with the metric fallacy. . . . Editors of newspapers knowing practically nothing about the subject have aped the schools and colleges, taught the fallacy and increased the ignorance. In the encouragement of the popular ignorance lies the chief danger to our established standards. p. 193.

> Advocates of the English system deny most emphatically that there is any demand worth serious consideration in favor of a change to the metric system in the United States. The deductions drawn from lists of names presented by the metric advocates . . . are wholly fallacious and misleading. . . . If this is the best the pro-metrics can show, only 60,000 to 80,000 people in the United States out of a population of one hundred millions—less than one tenth of one per cent. of the whole—favor a change. Such a demand . . . could be accounted for by the scientific group in this country, which comprises about this proportion of the population and is known to advocate the metric system. . . . The propaganda in favor of the metric system has emanated from one or two propaganda organizations working for the purpose, which have spread broadcast throughout the United States literature of an essentially misleading character. . . . The prominent individuals most frequently quoted as favoring the metric cause are not industrialists and business men, but such professional men as teachers, doctors, inventors and others who are interested chiefly in the scientific aspects of the question and have nothing of material value at stake or have espoused the cause as fallaciously represented by metric propagandists without having given due consideration to the practical side of the issue. p. 192.

We note that the American Association for the Advancement of Science, the American