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REPORT

OF

The Connecticut Agricultural
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NEW HAVEN, CONN.

ON

FOOD PRODUCTS AND DRUGS, 1922,
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BEING

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Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 240

AUGUST, 1922

BEING THE

Twenty-Seventh Report

ON

Food Products

AND

Fifteenth Report on Drug Products Part I (Commercial Vitamine Preparations)

By E. M. BAILEY.

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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August 1922

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The Potency of Some Commercial Vitamine Preparations as Compared with that of Dry Brewers' Yeast

BY E. M. BAILEY

with the collaboration of

HELEN C. CANNON AND H. J. FISHER.

INTRODUCTION.

It has been said that the discovery of vitamins has not shown us what to eat but has shown us rather, why we eat what we do; in other words it has demonstrated the logic of the mixed diet. With a free range of choice man and lower animals have instinctively chosen those natural foods which are necessary for adequate nourishment. However, under modern social and economic conditions and other circumstances beyond our control, freedom of choice in dietary matters may often become more a theoretical consideration than an accomplished fact. Thus famine may reduce the available supply of food; transportation facilities may interrupt its adequate distribution; extremes of climate may limit the variety; and the manipulation of natural food-stuffs in the so-called refining processes of commercial practice may remove essential constituents. Again, invalidism or convalescence may so impair appetite that the food intake may become insufficient in kind or quantity.

The exact chemical nature of vitamins is, at present, entirely speculative and the complete story of their significance in the diet remains to be told; nevertheless experimental evidence shows that a lack of these food factors results, directly or indirectly, in serious nutritional derangement. Thus has arisen much discussion, both in scientific and popular literature, upon the subject of deficiency diseases.

It is not our purpose here to discuss such diseases as beri-beri and scurvy, now, by consensus of opinion, attributed to faulty diets; nor such disorders as ophthalmia and polyneuritis which

can be developed and cured at will in experimental animals by dietetic measures. For such information the reader is referred to various texts and monographs.¹

Whatever may be the ultimate status of vitamins in therapeutics it may be remarked that the spectacle of an animal brought to a moribund condition on a diet intentionally made deficient in water-soluble B, for example, and recovering within the lapse of a few hours when a minute quantity of the lacking constituent is supplied, affords a most striking demonstration of the potency of these obscure factors. No doubt such demonstrations have linked vitamins with the idea of curative potency.

It is generally conceded that there is no danger of vitamin deficiency (avitaminosis), in the average mixed diet of the normal individuals; but in the case of infants on artificial diets or in cases of malnutrition, whenever found, the question of vitamin supply may well be taken into serious consideration. The extent to which vitamin-rich materials can be reasonably prescribed by physicians must be left to their more matured judgment based upon further clinical experience and observation. Much biased advertising literature and some popular discussions have conveyed the impression that everyone needs supplemental administrations of vitamins. A host of commercial vitamin preparations which purport to contain one or all of the necessary food factors in various degrees of concentration have appeared simultaneously with, or closely in the wake of, this publicity campaign. Some are offered to the medical profession on strictly ethical standards; others are offered to the laity under more or less extravagant claims. In response to numerous inquiries regarding the potency of these numerous products this station has undertaken to investigate some of the preparations more widely advertised in this state. Our attitude on the subject is quite similar to that which we hold with respect to diabetic foods, viz., that they should be offered under as definite statements regarding their substance, quality and strength as can be made; and that they should not be offered under declarations which foster the practice of self-medication. A statement of proximate composition, within reasonable limits, enables the physician or dietitian to decide whether

¹ Sherman, H. C. and Smith, S. L. *The Vitamins*. The Chemical Catalog Company, Inc., New York.

Plimmer, V. G. and R. H. A. *Vitamines and the Choice of Food*. Longmans, Green & Co., New York.

Lister Institute and Medical Research Committee. *Report on the Present Knowledge Concerning Accessory Food Factors (Vitamines)*. London.

Harrow, Benjamin. *Vitamines*. E. P. Dutton & Co., New York.

Funk, C. *The Vitamines*. Williams & Wilkins, Co., Baltimore.

Ellis, C. and Macleod, A. L. *Vital Factors in Foods*. D. Van Nostrand Co., New York.

or not a particular brand of diabetic food is suitable for the patient; or at least it furnishes a basis for intelligent determination of the patient's tolerance. So, in the case of vitamin preparations, biological methods of testing have been so far perfected that a reasonable statement of potency can be declared; and, in our opinion, the burden of responsibility properly rests with the manufacturer to ascertain and declare the potency of his product as a reasonable guide to its intelligent use. The indiscriminate offering of vitamin-bearing remedies under labels suggesting wide curative or remedial properties places them at once in the category of the ordinary patent or proprietary medicine.

One of the most prominently exploited sources of vitamin is yeast. Therapeutic properties have been ascribed to yeast since very remote times, but the discovery that it is comparatively rich in water-soluble B vitamin has given new impetus to the belief in the value of yeast in the diet. The majority of preparations which we have examined declare or imply either the presence of yeast or of water-soluble B vitamin and we have therefore chosen to evaluate them on the basis of their potency with respect to this factor whether from yeast or other source. We have proceeded on the reasonable hypothesis that a preparation which, in one hundred milligram doses, does not exhibit the potency shown by one hundred milligrams of a good grade of dry brewers' yeast, employed under comparable conditions, does not justify a claim of superior therapeutic value as a source of water-soluble B vitamin. We have, therefore, not attempted to evaluate, by means of increased dosage, the concentration of vitamin B in preparations which failed to equal or approximate the potency shown by our control product. Neither have we attempted to determine the potency of the various preparations with respect to other types of vitamins (vitamins A and C), whether or not such claims were made.

PLAN OF EXAMINATION.

Chemical analyses: The basis of judgment and comparison as to the potency of the various products examined is, of course, their effect when fed to experimental animals. In addition, however, determinations of certain proximate chemical constituents have been made which throw some light upon the general nature of the preparations.

The materials used were fed in the state and condition as offered for sale. Moisture was determined in all samples, but only in two cases, viz., in Fleischmann's yeast and Vegex, was account taken of water content in fixing the daily rations. Fleischmann's yeast was fed with a correction of 66 per cent and Vegex with a

correction of 32 per cent for moisture. Other preparations contained from three to eight per cent of moisture and were regarded as dry material and so fed.

Biological tests: Tablets or powders were reground when necessary and pressed into 50 or 100 milligram tablets in a tableting machine. Moist or pasty preparations were weighed on an analytical balance for each feeding. Yeastone (Merck) could not be reduced to satisfactory tablets. The pills were finely pulverized, after which 100 milligram portions were weighed and placed in gelatin capsules. For feeding, the contents of a capsule was emptied into the vitamine cup. For controls 100 milligram, 50 milligram and 25 milligram tablets of dry brewers' yeast were used.

Young albino rats were the experimental animals used in all cases. The basic plan was to test each preparation upon three animals and, accordingly, three separate series of tests were made. In Series I, 100 milligrams of the dry material, or an amount of moist preparation equivalent thereto, were fed to each rat once daily. Series II was a repetition of Series I except that the sexes were reversed and in case of such products as had produced normal growth, or growth approaching normal, on the first trial the daily dose was reduced to 50 milligrams. In Series III 50 or 100 milligram doses were fed according to results obtained in preceding trials. For this series new samples of the vitamine products were used except in the case of Vita Zest of which a second sample could not be secured. (In a few instances fourth trials were made either to test smaller doses or to check previous trials). With Fleischmann's yeast numerous samples were tried, a fresh cake being purchased every three days and kept properly refrigerated during that time.

The plan of an individual test was as follows:¹

A young rat was placed in an individual cage with a sufficient supply of food,² adequate in all respects except that it was lacking water-soluble B vitamine, constantly before it. The weight of the animal was charted twice each week with such intermediate check weights as circumstances required. With water-soluble B absent from the diet appetite fails, food intake is diminished and body weight declines. When the animal had shown a persistent and conspicuous decline in weight the trial unit quantity of commercial vitamine preparation was added to its diet daily. The duration of the test depended upon the behavior of the animal.

¹ Procedure of Osborne, Mendel and Wakeman.

² Composed as follows: casein 18 parts, starch 54 parts, lard 15 parts, butter-fat 9 parts, inorganic salts 4 parts. (For the composition of the inorganic salt mixture see Osborne and Mendel, Jour. Biol. Chem., 37, 572).

If it recovered and increased in weight the trial was terminated when the animal had acquired its normal weight. If it did not recover but continued to decline the commercial vitamine under test was withdrawn, an equal quantity of dry brewers' yeast substituted and the recovery period made sufficiently long to demonstrate that the animal still possessed recuperative powers. Dry brewers' yeast was administered in all cases where the commercial preparation itself did not bring the animal to normal. In general a trial period of about thirty days, unless necessarily terminated earlier, was allowed and followed by a recovery period of about twenty-one days.

LIST OF PRODUCTS.

The following preparations were examined:

Brewers' Yeast (Control).	Vi-ta-co.
Cerevisine, (tablets and granules).	Vitamon, Mastin's.
Fleischmann's Yeast.	Vita Zest.
Ironized Yeast.	Yeastamine.
Magic Yeast.	Yeast Foam Tablets.
Medic Yeest.	Yeastone.
Merck's Yeast, Medicinal, (tablets and powder).	Yeastonic.
Metagen.	Yeast Vitamine-Harris (tablets).
Phos-pho Vitamine.	Yeast Vitamine-Harris (powder).
Phytamin.	Yeast Vitamine, Nuxated Brand.
VegeX.	

RESULTS OF EXAMINATION.

Information regarding the products examined as given on the labels or in accompanying literature, the results of partial chemical analyses and of biological tests together with growth charts are given in the following pages. It may be restated here that the quantities of dry brewers' yeast fed at the end of the experimental periods were equal to the quantities of commercial vitamine fed during the corresponding experimental periods.

STATION No. 18441, DRY BREWERS' YEAST (CONTROL).

The brewers' yeast used was the dry commercial product reground. This is the yeast which has been studied and used so extensively by Osborne and Mendel in their investigations of vitamins.

Chemical examination: Partial analysis showed the following composition:

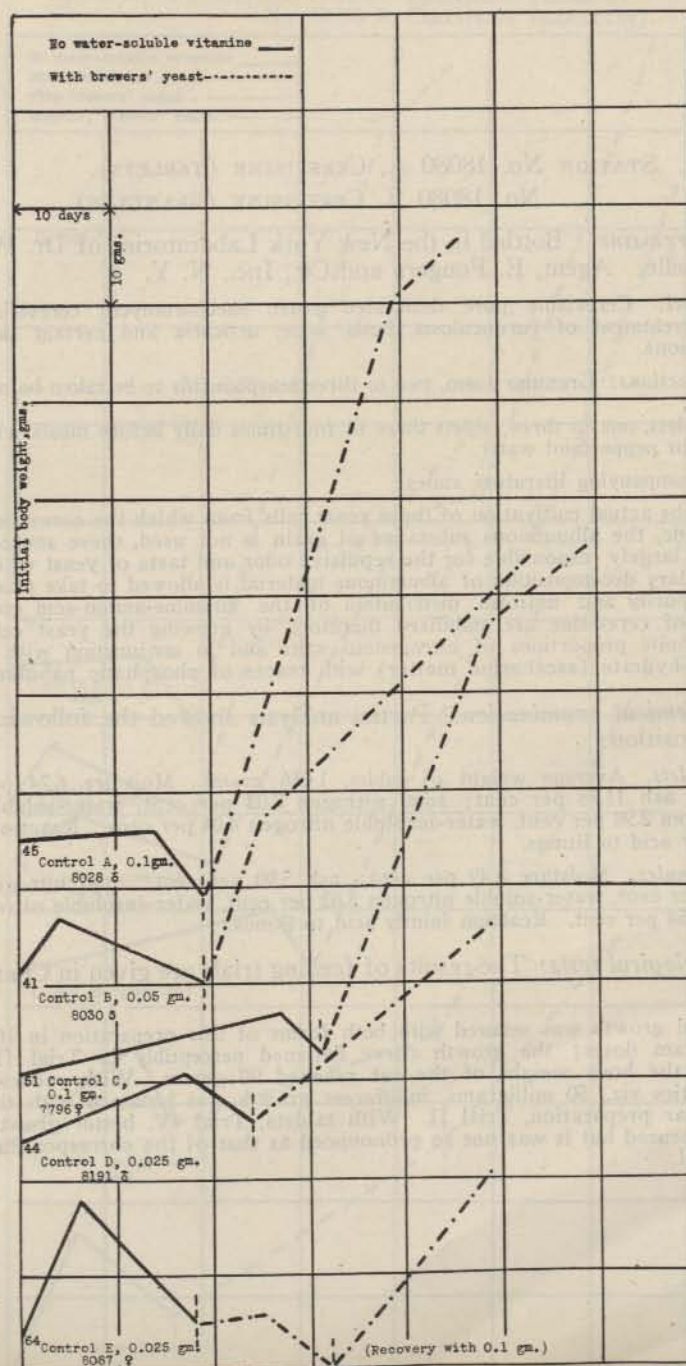
Moisture 7.90 per cent; ash 7.08 per cent; total nitrogen 7.24 per cent, water-soluble nitrogen 1.53 per cent, water-insoluble nitrogen 5.71 per cent. Reaction, faintly acid to litmus.

The ash content may vary considerably with different types of yeast although the limits stated are not materially different, viz., for top yeast 2.5 to 11.5 per cent; for bottom yeast 3.5 to 10.1 per cent. Potassium phosphate is the most conspicuous constituent of the ash. On the ash-free, dry material several investigators agree upon a nitrogen content of 11.5 per cent for top yeast and 8.7 per cent for bottom yeast.¹

Biological tests: The results of feeding trials are given in Chart I.

No comment is necessary upon the growth curves other than to note that with 25 milligram doses failure resulted in one of the two trials made. Control E, however, was made with a rat of considerable size; a better result was obtained with an animal of less initial body weight (Control D). Attention is directed also to Chart XI, Trial IV in which fair recovery was made with 25 milligrams after failure. It is evident that this dose approaches the lower limit of efficiency, and that it may or may not be effective depending upon the recuperative power of the animal, and particularly its degree of maturity.

CHART I. STATION No. 18441, DRY BREWERS' YEAST (CONTROL).



¹ Allen. Commercial Org. Anal., Vol I, p. 208, 4th Ed.

STATION No. 18080 A, CEREVISINE (TABLETS).
 No. 18080 B, CEREVISINE (GRANULES).

Cerevisine. Bottled in the New York Laboratories of Dr. Ph. Chapelle. Agent, E. Fougera and Co., Inc., N. Y.

Label: Cerevisine pure desiccated yeast, *saccharomyces cerevisiae*. For treatment of furunculosis, boils, acne, urticaria and certain skin affections.

Directions: Granular form, two to three teaspoonfuls to be taken before meals.

Tablets, one to three tablets three to four times daily before meals with plain or peppermint water.

Accompanying literature states:

In the actual cultivation of these yeast cells from which the cerevisine is made, the albuminous substance of grain is not used, these sources being largely responsible for the repulsive odor and taste of yeast when secondary decomposition of albuminous material is allowed to take place. The purity and uniform distribution of the vitamine-amino-acid contents of cerevisine are stabilized therefore, by growing the yeast cells in definite proportions of nitrogenous salts and in conjunction with a carbo-hydrate (saccharine matter) with traces of phosphatic pabulum.

Chemical examination: Partial analysis showed the following composition:

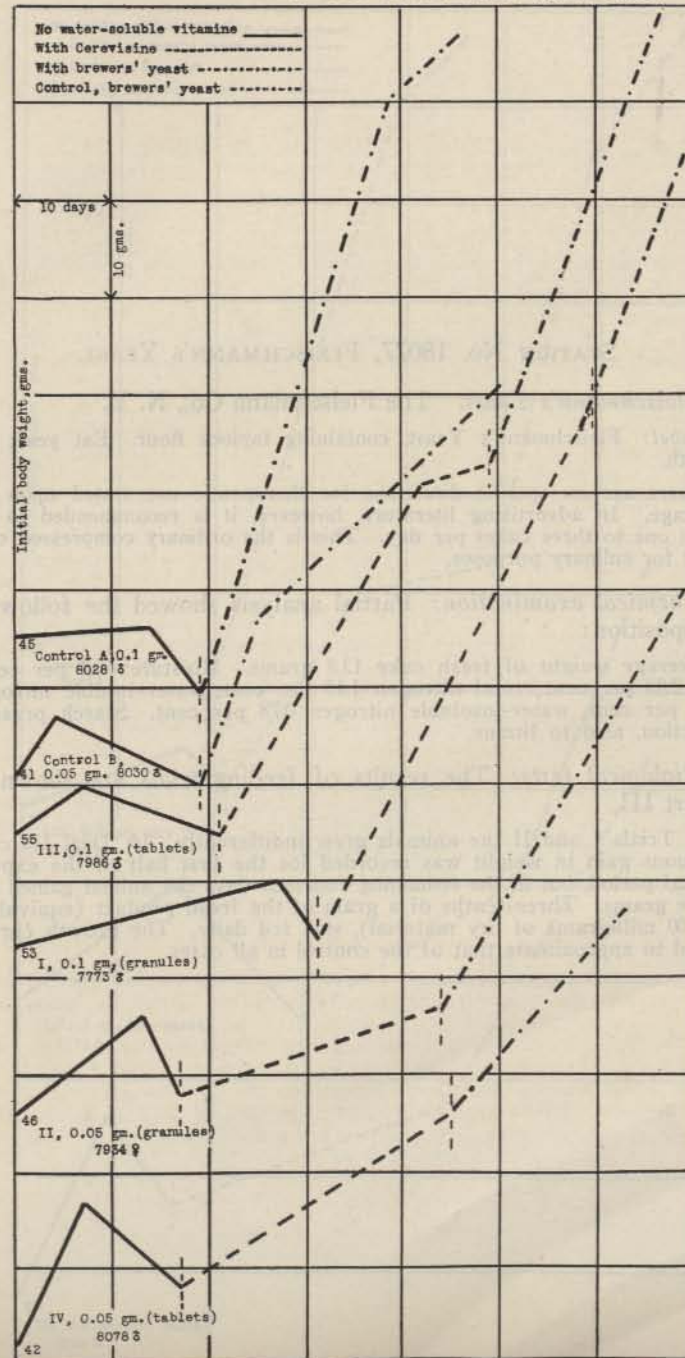
Tablets. Average weight of tablet, 1.056 grams. Moisture 6.74 per cent; ash 11.78 per cent; total nitrogen 7.02 per cent, water-soluble nitrogen 2.98 per cent, water-insoluble nitrogen 4.04 per cent. Reaction, faintly acid to litmus.

Granules. Moisture 8.49 per cent; ash 5.90 per cent; total nitrogen 8.16 per cent, water-soluble nitrogen 3.62 per cent, water-insoluble nitrogen 4.54 per cent. Reaction faintly acid to litmus.

Biological tests: The results of feeding trials are given in Chart II.

Good growth was secured with both forms of this preparation in 100 milligram doses; the growth curve flattened perceptibly in Trial III when the body weight of the rat reached 90 grams. With reduced quantities viz., 50 milligrams, indifferent growth was obtained with the granular preparation, Trial II. With tablets, Trial IV, better growth was secured but it was not so pronounced as that of the corresponding control.

CHART II. STATION No. 18080 A, CEREVISINE (TABLETS).
 No. 18080 B, CEREVISINE (GRANULES).



STATION No. 18077, FLEISCHMANN'S YEAST.

Fleischmann's Yeast. The Fleischmann Co., N. Y.

Label: Fleischmann's Yeast, containing tapioca flour. Eat yeast for health.

There are no specific directions for therapeutic use stated upon the package. In advertising literature, however, it is recommended to eat from one to three cakes per day. This is the ordinary compressed cake used for culinary purposes.

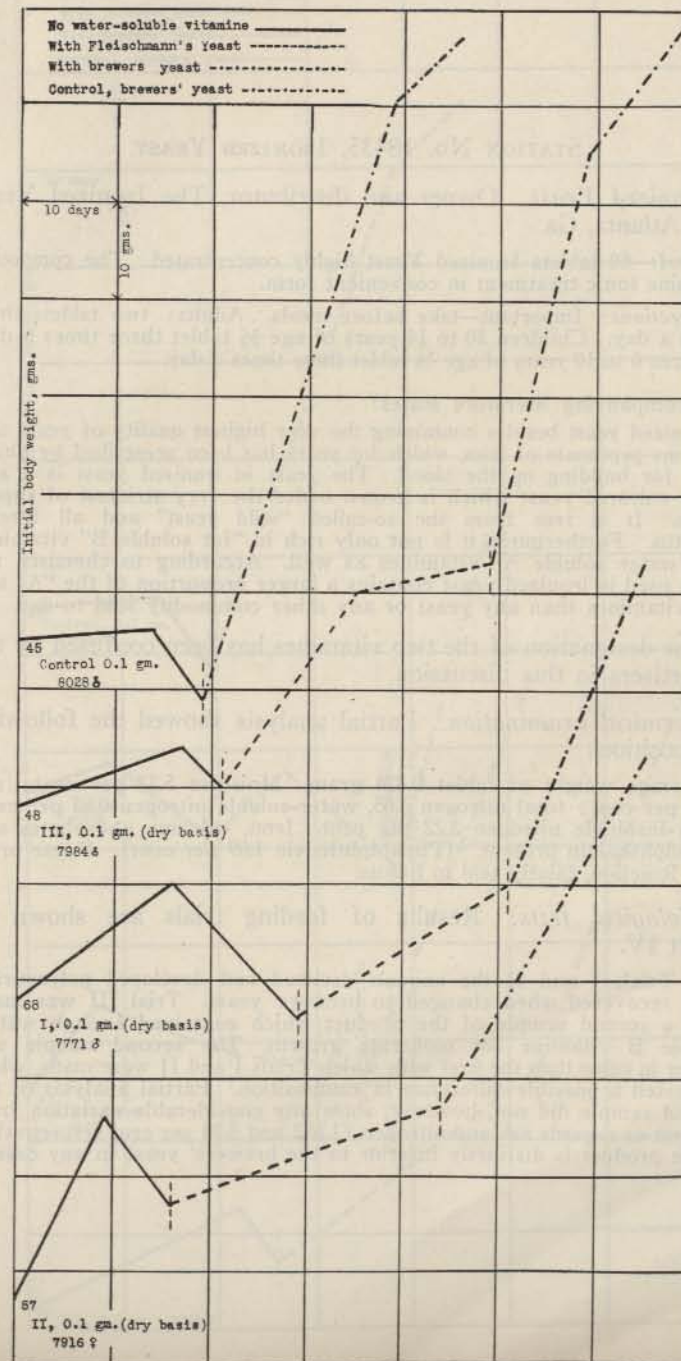
Chemical examination: Partial analysis showed the following composition:

Average weight of fresh cake 13.8 grams. Moisture 65.4 per cent; ash 2.83 per cent; total nitrogen 1.15 per cent, water-soluble nitrogen 0.37 per cent, water-insoluble nitrogen 0.78 per cent. Starch present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart III.

In Trials I and II the animals grew indifferently. In Trial III conspicuous gain in weight was recorded for the first half of the experimental period, but in the remaining fourteen days the animal gained but three grams. Three-tenths of a gram of the fresh product (equivalent to 100 milligrams of dry material), was fed daily. The growth curves failed to approximate that of the control in all cases.

CHART III. STATION No. 18077, FLEISCHMANN'S YEAST.



STATION No. 18435, IRONIZED YEAST.

Ironized Yeast. Owner and distributor, The Ironized Yeast Co., Atlanta, Ga.

Label: 60 tablets Ironized Yeast highly concentrated. The compound vitamine tonic treatment in convenient form.

Directions: Important—take before meals. Adults: two tablets three times a day. Children 10 to 14 years of age ½ tablet three times a day. Children 6 to 10 years of age ¼ tablet three times a day.

Accompanying literature states:

Ironized yeast besides containing the very highest quality of yeast also contains peptonate of iron, which for years has been prescribed by physicians for building up the blood. The yeast in ironized yeast is a specially cultured yeast which is grown under the very strictest of supervision. It is free from the so-called "wild yeast" and all foreign growths. Furthermore, it is not only rich in "fat soluble B" vitamins but "water soluble A" vitamins as well. According to chemists, the yeast used in ironized yeast contains a larger proportion of the "A" and "B" vitamins than any yeast or any other commodity sold to-day.

The designation of the two vitamins has been confused by the advertisers in this discussion.

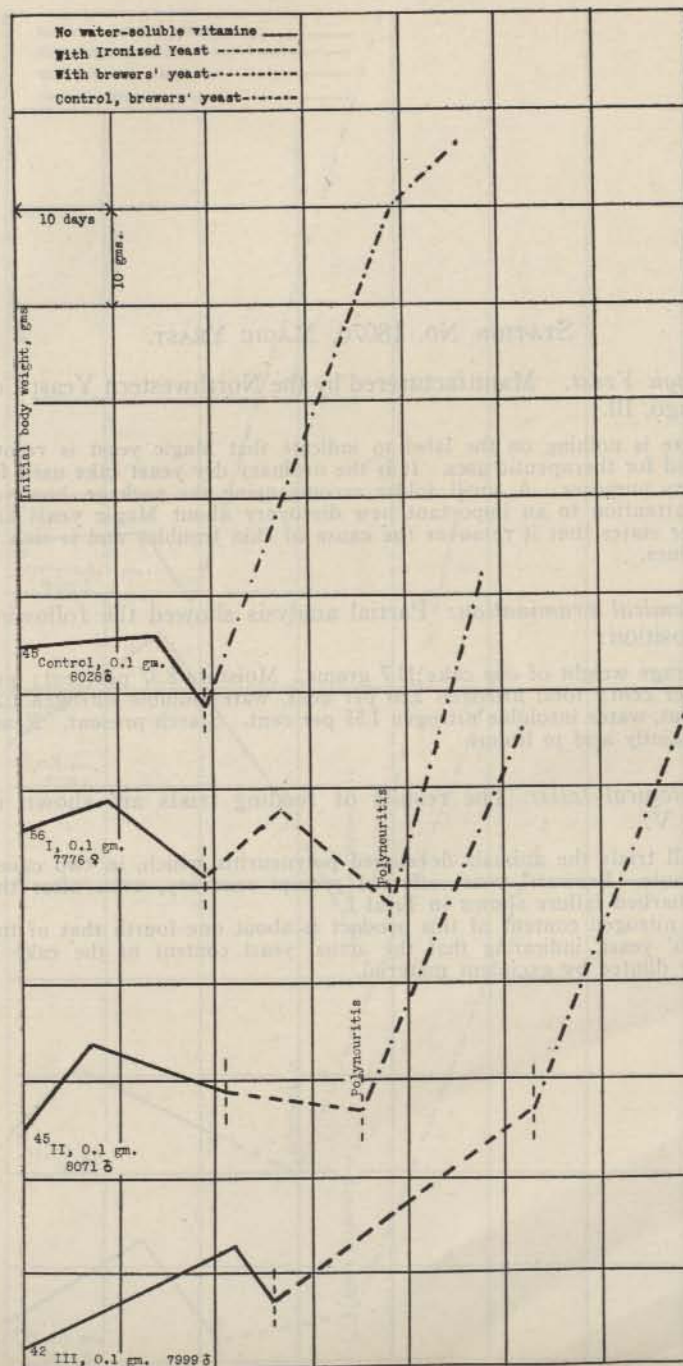
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.424 gram. Moisture 5.32 per cent; ash 15.13 per cent; total nitrogen 4.05, water-soluble nitrogen 0.83 per cent, water-insoluble nitrogen 3.22 per cent. Iron, calcium, phosphates and phenolphthalein present. (Phenolphthalein 1.09 per cent). Sugar present. Reaction, faintly acid to litmus.

Biological tests: Results of feeding trials are shown in Chart IV.

In Trials I and II the animals declined and developed polyneuritis. Both recovered when changed to brewers' yeast. Trial III was made with a second sample of the product which contained enough water-soluble B vitamine for moderate growth. The second sample was darker in color than the first with which Trials I and II were made, which suggested a possible difference in composition. Partial analysis of the second sample did not, however, show any considerable variation from the first as regards ash and nitrogen (13.82 and 3.94 per cent respectively). The product is distinctly inferior to the brewers' yeast in any case.

CHART IV. STATION No. 18435, IRONIZED YEAST.



STATION No. 18076, MAGIC YEAST.

Magic Yeast. Manufactured by the Northwestern Yeast Co., Chicago, Ill.

There is nothing on the label to indicate that Magic yeast is recommended for therapeutic uses. It is the ordinary dry yeast cake used for culinary purposes. A small folder accompanying the package, however, calls attention to an important new discovery about Magic yeast and further states that it removes the cause of skin troubles and is rich in vitamins.

Chemical examination: Partial analysis showed the following composition:

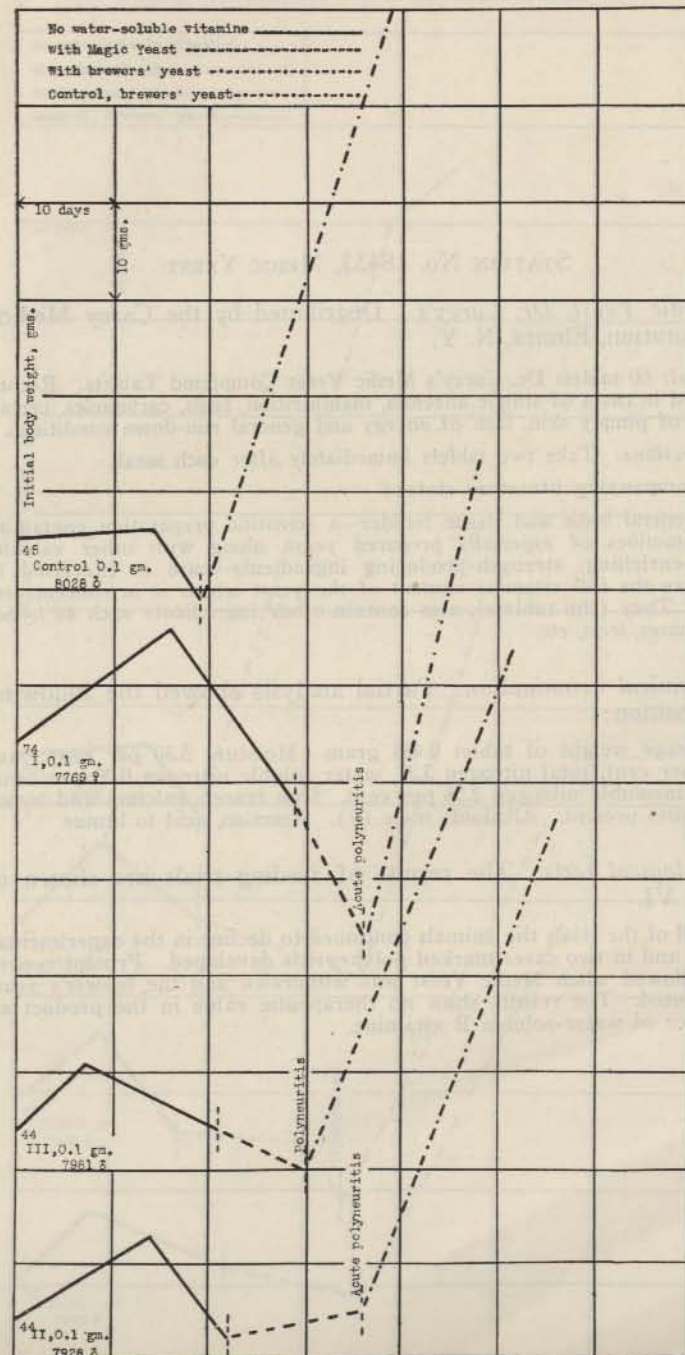
Average weight of one cake 11.7 grams. Moisture 8.37 per cent; ash 2.22 per cent; total nitrogen 1.80 per cent, water-soluble nitrogen 0.25 per cent, water insoluble nitrogen 1.55 per cent. Starch present. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart V.

In all trials the animals developed polyneuritis which, in two cases, was acute. Brewers' yeast effected prompt recovery, even after the very marked failure shown in Trial I.

The nitrogen content of this product is about one-fourth that of the brewers' yeast, indicating that the actual yeast content of the cake is largely diluted by excipient material.

CHART V. STATION No. 18076, MAGIC YEAST.



STATION No. 18433, MEDIC YEEST.

Medic Yeest, Dr. Carey's. Distributed by the Carey Medical Corporation, Elmira, N. Y.

Label: 60 tablets Dr. Carey's Medic Yeest Compound Tablets. Recommended in cases of simple anaemia, malnutrition, boils, carbuncles, certain forms of pimply skin, lack of energy and general run-down conditions.

Directions: Take two tablets immediately after each meal.

Accompanying literature states:

A general tonic and tissue builder—a scientific preparation containing the vitamins of especially prepared yeast, along with other valuable blood-enriching, strength-producing ingredients—care is exercised to conserve the full vitamin content of the yeast which is in concentrated form. They (the tablets), also contain other ingredients such as hypophosphates, iron, etc.

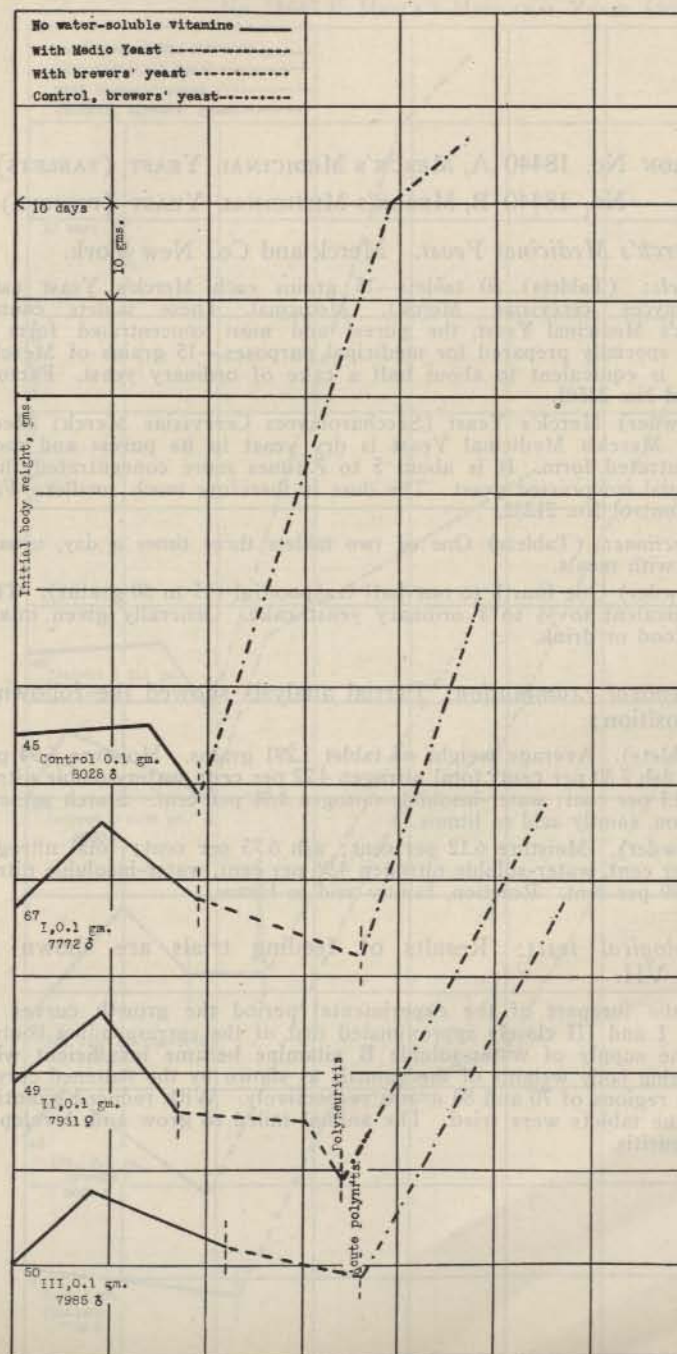
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.458 gram. Moisture 5.30 per cent; ash 24.34 per cent, total nitrogen 3.37, water-soluble nitrogen 0.79 per cent; water-insoluble nitrogen 2.58 per cent. Iron trace; calcium and hypophosphites present. Alkaloids trace (?). Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart VI.

In all of the trials the animals continued to decline in the experimental period and in two cases marked polyneuritis developed. Prompt recovery followed when Medic Yeest was withdrawn and the brewer's yeast substituted. The results show no therapeutic value in the product as a source of water-soluble B vitamins.

CHART VI. STATION No. 18433, MEDIC YEEST.



STATION No. 18440 A, MERCK'S MEDICINAL YEAST (TABLETS).
 No. 18440 B, MERCK'S MEDICINAL YEAST (POWDER).

Merck's Medicinal Yeast. Merck and Co., New York.

Labels: (Tablets) 50 tablets—15 grains each Merck's Yeast (*saccharomyces cerevisiae* Merck), Medicinal. These tablets contain Merck's Medicinal Yeast, the purest and most concentrated form of yeast, specially prepared for medicinal purposes.—15 grains of Merck's Yeast is equivalent to about half a cake of ordinary yeast. Factory control No. 23501.

(Powder) Merck's Yeast (*Saccharomyces Cerevisiae* Merck) Medicinal. Merck's Medicinal Yeast is dry yeast in its purest and most concentrated form. It is about 5 to 7 times more concentrated than the usual compressed yeast. The dose is therefore much smaller.—Factory control No. 21232.

Directions: (Tablets) One or two tablets three times a day, usually given with meals.

(Powder) One fourth to one-half teaspoonful (15 to 30 grains). This is equivalent to 1/2 to 1 ordinary yeast cake. Generally given mixed with food or drink.

Chemical examination: Partial analysis showed the following composition:

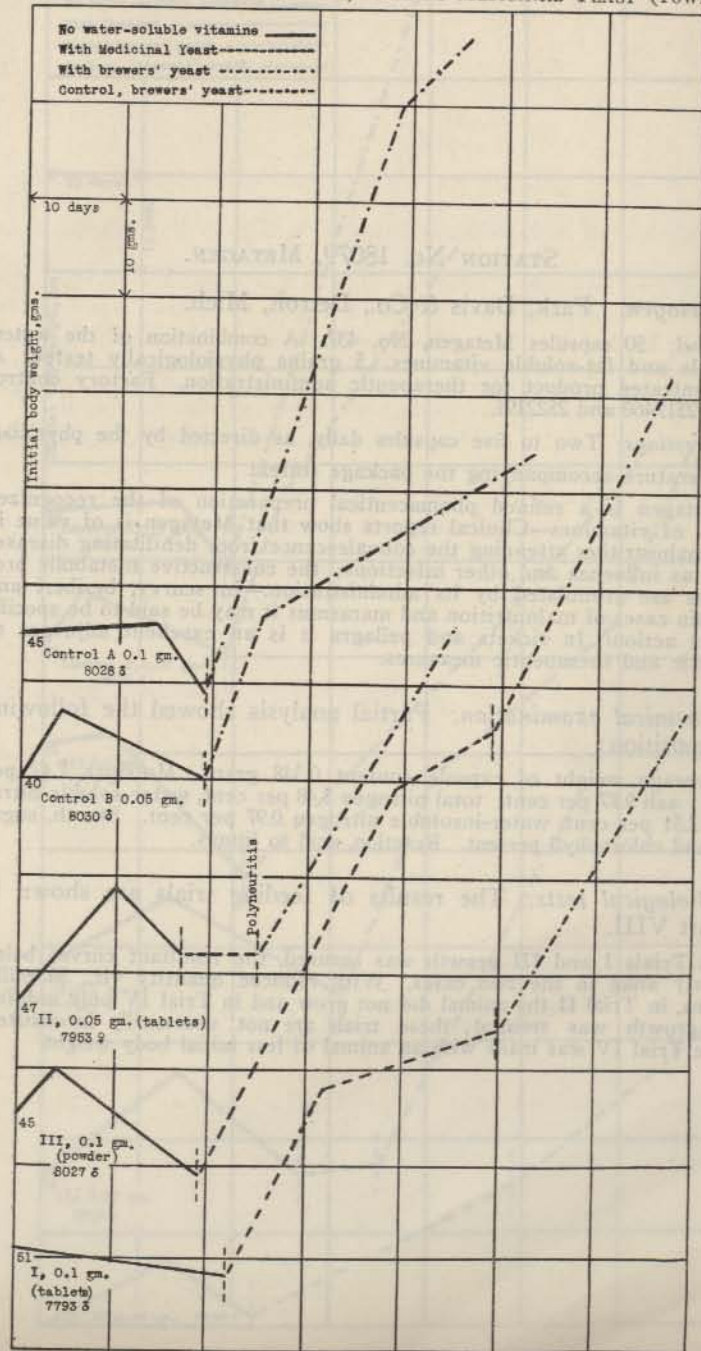
(Tablets). Average weight of tablet 1.291 grams. Moisture 6.94 per cent; ash 7.30 per cent; total nitrogen 4.72 per cent, water-soluble nitrogen 28.1 per cent; water-insoluble nitrogen 1.91 per cent. Starch present. Reaction, faintly acid to litmus.

(Powder). Moisture 6.12 per cent; ash 6.75 per cent; total nitrogen 8.95 per cent, water-soluble nitrogen 4.96 per cent, water-insoluble nitrogen 3.99 per cent. Reaction, faintly acid to litmus.

Biological tests: Results of feeding trials are shown in Chart VII.

In the forepart of the experimental period the growth curves in Trials I and III closely approximated that of the corresponding control but the supply of water-soluble B vitamine became insufficient with increasing body weights of the animals as shown by the flattened curves in the regions of 70 and 80 grams respectively. With reduced quantity only the tablets were tried. The animal failed to grow and developed polyneuritis.

CHART VII. STATION No. 18440 A, MERCK'S MEDICINAL YEAST (TABLETS).
 No. 18440 B, MERCK'S MEDICINAL YEAST (POWDER).



STATION No. 18079, METAGEN.

Metagen. Park, Davis & Co., Detroit, Mich.

Label: 50 capsules Metagen, No. 437. A combination of the water-soluble and fat-soluble vitamins. 5 grains physiologically tested. A concentrated product for therapeutic administration. Factory control Nos. 2517460 and 2522191.

Directions: Two to five capsules daily, as directed by the physician.

Literature accompanying the package states:

Metagen is a refined pharmaceutical preparation of the recognized types of vitamins—Clinical reports show that Metagen is of value in the malnutrition attending the convalescence from debilitating diseases such as influenza and other infections; the constructive metabolic processes are stimulated by its administration.—In scurvy, beriberi and certain cases of malnutrition and marasmus it may be said to be specific in its action. In rickets and pellagra it is an excellent adjuvant to dietetic and therapeutic measures.

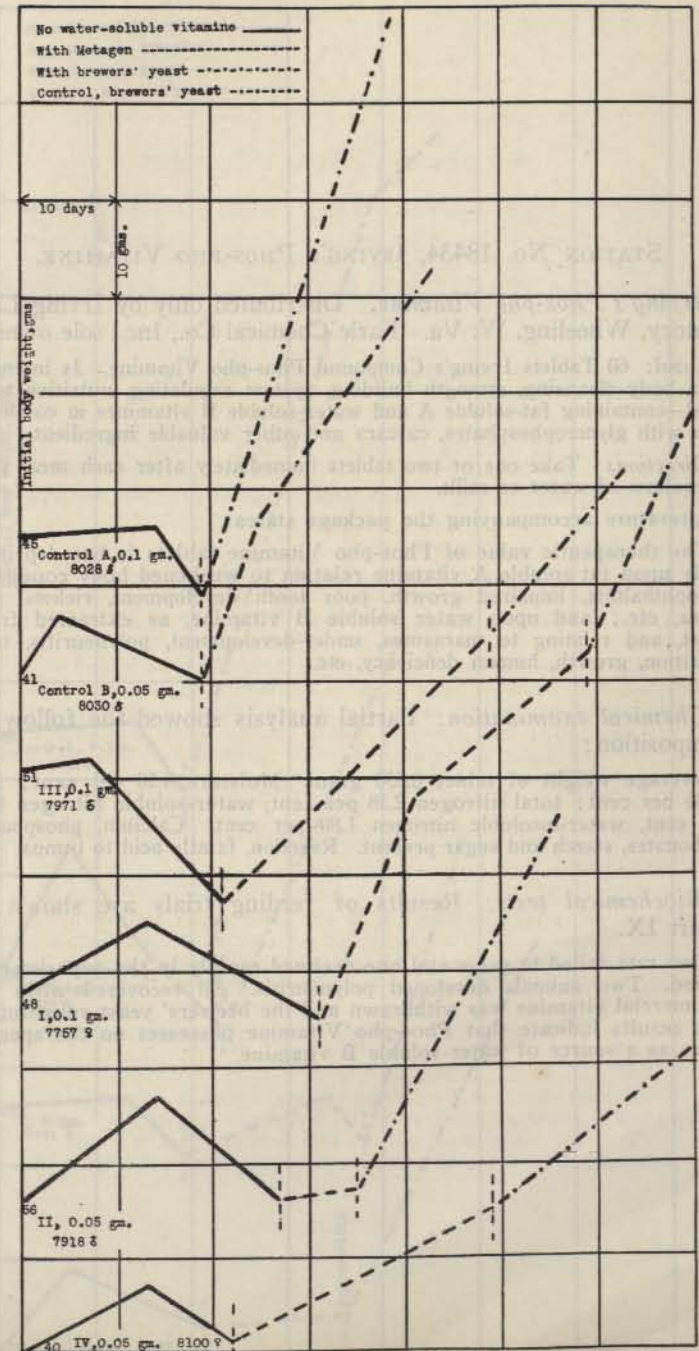
Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.348 gram. Moisture 7.42 per cent; ash 9.87 per cent; total nitrogen 3.48 per cent, water-soluble nitrogen 2.51 per cent, water-insoluble nitrogen 0.97 per cent. Starch, sugar fat and chlorophyll present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart VIII.

In Trials I and III growth was secured, the resultant curves being closely alike in the two cases. With reduced quantity viz., 50 milligrams, in Trial II the animal did not grow and in Trial IV only indifferent growth was secured; these trials are not necessarily inconsistent since Trial IV was made with an animal of less initial body weight.

CHART VIII. STATION No. 18079, METAGEN.



STATION No. 18434, IRVING'S PHOS-PHO VITAMINE.

Irving's Phos-pho Vitamine. Distributed only by Irving Laboratory, Wheeling, W. Va. Earle Chemical Co., Inc., sole owners.

Label: 60 Tablets Irving's Compound Phos-pho Vitamine. Is intended as a body cleansing, strength building, system regulating, nutritive tonic food—containing fat-soluble A and water-soluble B vitamins in combination with glycerophosphates, cascara and other valuable ingredients.

Directions: Take one or two tablets immediately after each meal with a swallow of water or milk.

Literature accompanying the package states:

The therapeutic value of Phos-pho Vitamine tablets is based principally upon fat soluble A vitamine relating to weakened body condition, xerophthalmia, impaired growth, poor tooth development, rickets, pellagra, etc.; and upon water soluble B vitamine, as extracted from yeast, and relating to marasmus, under-development, polyneuritis, malnutrition, growth, human deficiency, etc.

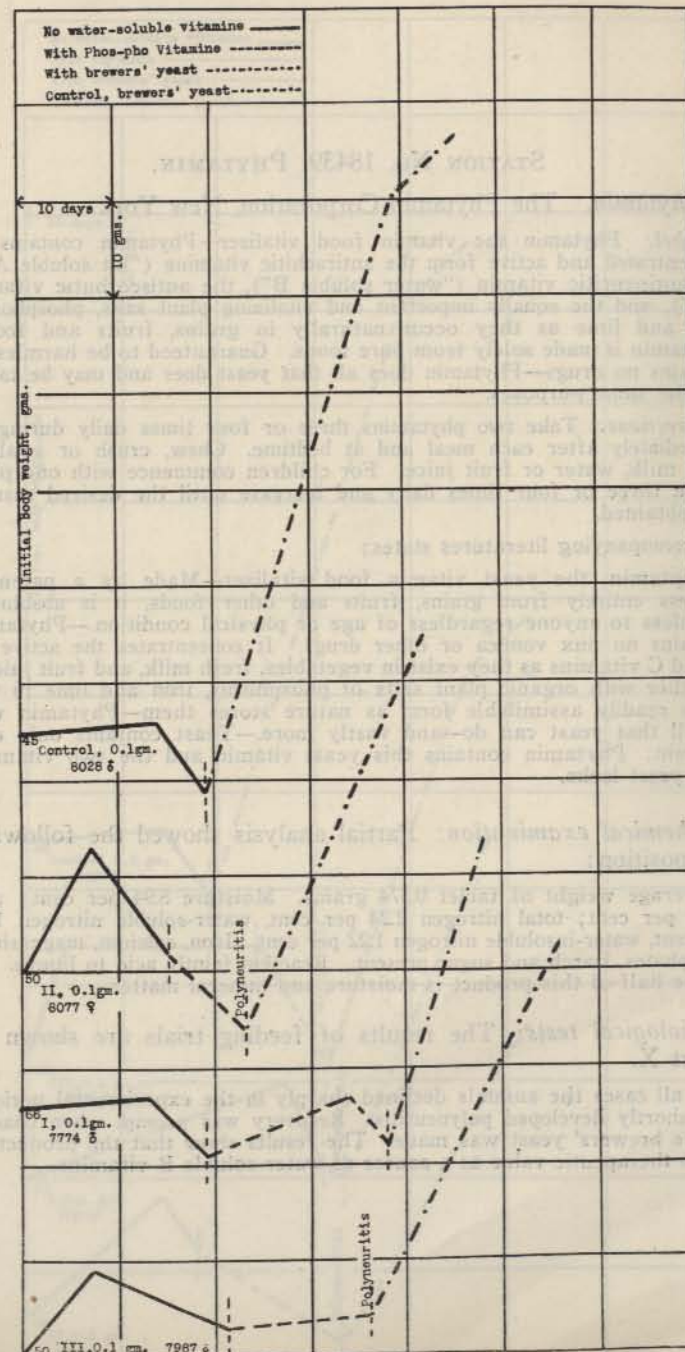
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.530 gram. Moisture 4.58 per cent; ash 32.46 per cent; total nitrogen 2.38 per cent, water-soluble nitrogen 0.58 per cent, water-insoluble nitrogen 1.80 per cent. Calcium, phosphates, carbonates, starch and sugar present. Reaction, faintly acid to litmus.

Biochemical tests: Results of feeding trials are shown in Chart IX.

Two rats failed to grow and one declined rapidly in the experimental period. Two animals developed polyneuritis. All recovered when the commercial vitamine was withdrawn and the brewers' yeast substituted. The results indicate that Phos-pho Vitamine possesses no therapeutic value as a source of water-soluble B vitamine.

CHART IX. STATION No. 18434, PHOS-PHO VITAMINE.



STATION No. 18439, PHYTAMIN.

Phytamin. The Phytamin Corporation, New York.

Label: Phytamin the vitamin food vitalizer—Phytamin contains in concentrated and active form the antirachitic vitamine ("fat soluble A"), the antineuritic vitamin ("water soluble B"), the antiscorbutic vitamin ("C"), and the equally important and vitalizing plant salts, phosphorus, iron and lime as they occur naturally in grains, fruits and foods. Phytamin is made solely from pure foods. Guaranteed to be harmless—contains no drugs—Phytamin does all that yeast does and may be taken for the same purposes.

Directions: Take two phytamins three or four times daily during or immediately after each meal and at bedtime. Chew, crush or swallow with milk, water or fruit juice. For children commence with one phytamin three or four times daily and increase until the desired results are obtained.

Accompanying literatures states:

Phytamin, the yeast vitamin food vitalizer—Made by a patented process entirely from grains, fruits and other foods, it is absolutely harmless to anyone regardless of age or physical condition.—Phytamin contains no nux vomica or other drugs. It concentrates the active A, B and C vitamins as they exist in vegetables, fresh milk, and fruit juices, together with organic plant salts of phosphorus, iron and lime in the same readily assimilable form as nature stores them—Phytamin will do all that yeast can do—and vastly more.—Yeast contains only one vitamin: Phytamin contains this yeast vitamin and the two vitamins that yeast lacks.

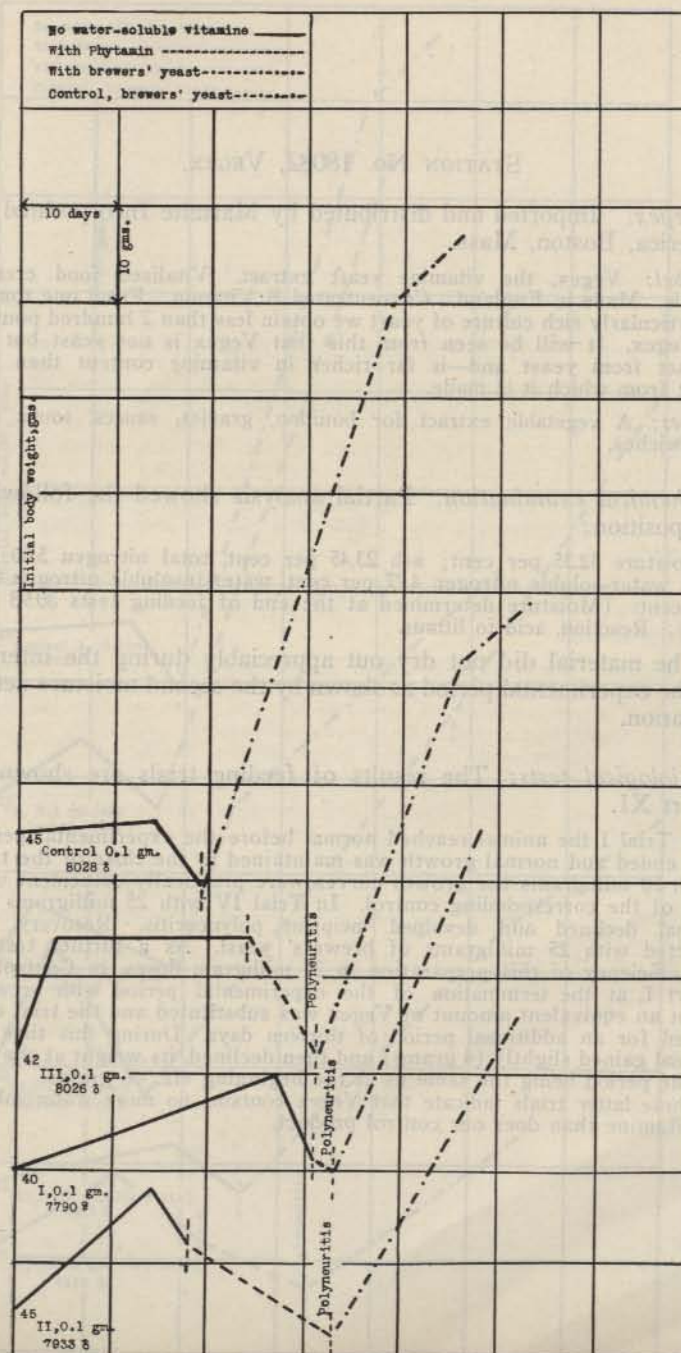
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.574 grams. Moisture 8.94 per cent; ash 40.91 per cent; total nitrogen 2.24 per cent, water-soluble nitrogen 1.02 per cent, water-insoluble nitrogen 1.22 per cent. Iron, calcium, magnesium, phosphates, starch and sugar present. Reaction faintly acid to litmus.

One half of this product is moisture and mineral matter.

Biological tests: The results of feeding trials are shown in Chart X.

In all cases the animals declined sharply in the experimental periods and shortly developed polyneuritis. Recovery was prompt when change to the brewers' yeast was made. The results show that the product is of no therapeutic value as a source of water-soluble B vitamine.



STATION No. 18082, VEGEX.

Vegex. Imported and distributed by Marmite Incorporated of America, Boston, Mass.

Label: Vegex, the vitamine yeast extract. Vitalized food creates health. Made in England. Concentrated B Vitamin. From one ton of a particularly rich culture of yeast we obtain less than 2 hundred pounds of Vegex. It will be seen from this that Vegex is not yeast but an extract from yeast and—is far richer in vitamine content than the yeast from which it is made.

Uses: A vegetable extract for bouillon, gravies, sauces, soups and sandwiches.

Chemical examination: Partial analysis showed the following composition:

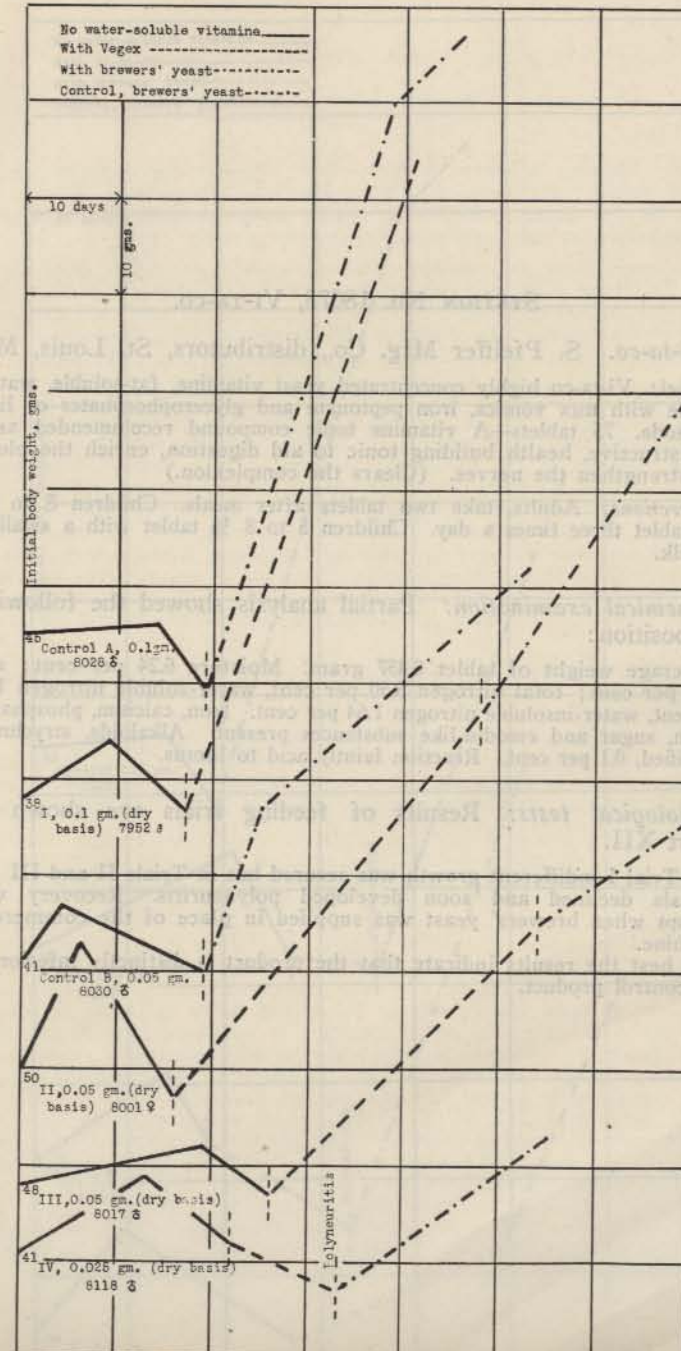
Moisture 32.35 per cent; ash 23.45 per cent, total nitrogen 5.00 per cent, water-soluble nitrogen 4.77 per cent, water-insoluble nitrogen 0.23 per cent. (Moisture determined at the end of feeding tests 30.98 per cent). Reaction, acid to litmus.

The material did not dry out appreciably during the interval of the experimental period as shown by the second moisture determination.

Biological tests: The results of feeding trials are shown in Chart XI.

In Trial I the animal reached normal before the experimental period was ended and normal growth was maintained to the close of the trial. With 50 milligrams the growth curves were practically coincident with that of the corresponding control. In Trial IV with 25 milligrams the animal declined and developed incipient polyneuritis. Recovery was effected with 25 milligrams of brewers' yeast. As a further test of the efficiency of this preparation in 25 milligram doses, in Control D, Chart I, at the termination of the experimental period with brewers' yeast an equivalent amount of Vegex was substituted and the trial continued for an additional period of thirteen days. During this time the animal gained slightly (4 grams) and then declined, its weight at the end of the period being the same as at the beginning viz., 66 grams.

These latter trials indicate that Vegex contains no more water-soluble B vitamine than does our control product.



STATION No. 18083, VITA ZEST.

Vita Zest. Vita-Zest Company, Inc., New York.

Label: 50 capsules Vita Zest with vitamins, a concentrated mixture of yeast (*saccharomyces cerevisiae*), and water-soluble and fat-soluble vitamins.

Directions: Three to four capsules daily before or after meals.

Accompanying literature states:

Vita Zest contains the best grade pure desiccated yeast—and concentrated water-soluble and fat-soluble vitamins—Types of vitamins (all of which are present in Vita Zest): Vitamine A, fat-soluble—Vitamine B, water-soluble—Vitamine C, water-soluble. Vita Zest does not contain any drugs and is simply a corrective food.

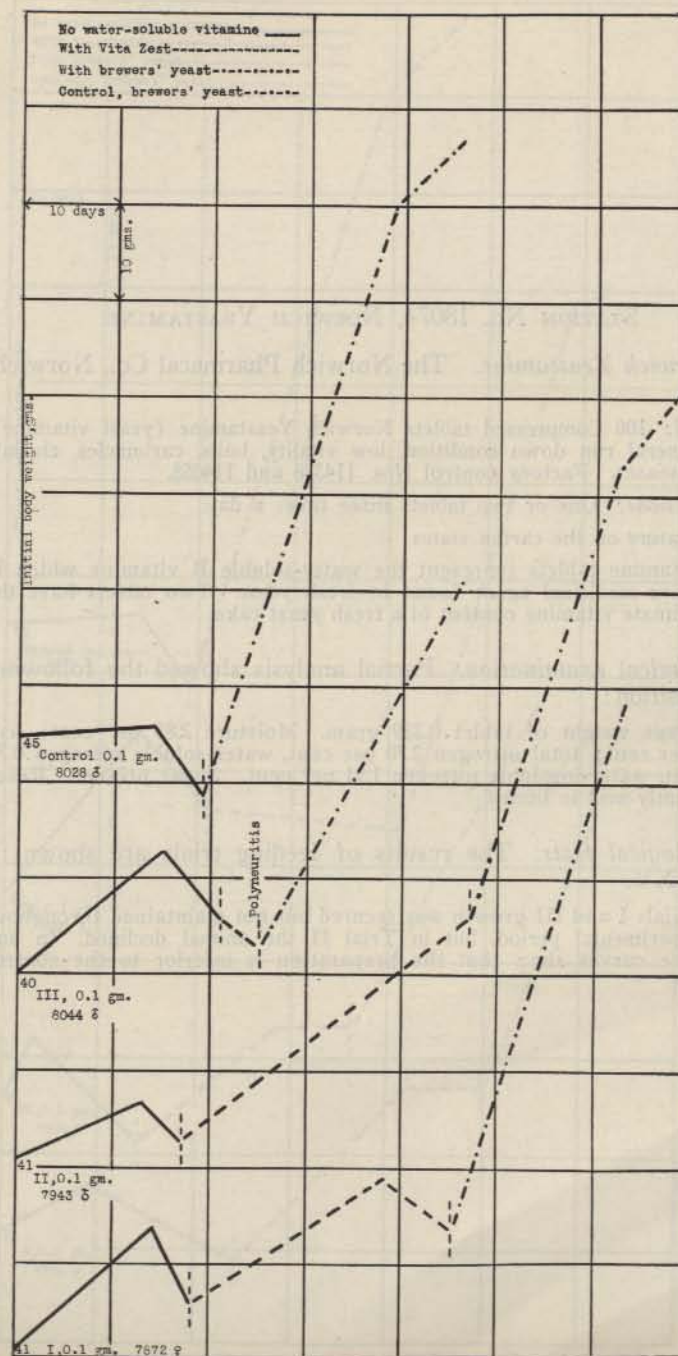
Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.441 gram. Moisture 8.54 per cent; ash 7.42 per cent; total nitrogen 6.91 per cent, water-soluble nitrogen 2.94 per cent, water-insoluble nitrogen 3.97 per cent. Phosphates, fat and sugar present. Reaction slightly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XIV.

In two trials the rats made moderate gains; in one growth was sustained throughout the experimental period but in the other it was not. In the third trial the animal declined and developed polyneuritis. The results are inconsistent but the preparation did not exhibit the potency of the brewers' yeast in any of the trials. Recovery curves in all cases were normal.

CHART XIV. STATION No. 18083, VITA ZEST.



STATION No. 18074, NORWICH YEASTAMINE.

Norwich Yeastamine. The Norwich Pharmacal Co., Norwich, N. Y.

Label: 100 Compressed tablets Norwich Yeastamine (yeast vitamine). For general run down condition, low vitality, boils, carbuncles, chronic skin diseases. Factory control Nos. 114388 and 114658.

Directions: One or two tablets three times a day.

Literature on the carton states:

Yeastamine tablets represent the water-soluble B vitamine which is the active medicinal agent found in fresh yeast. Two tablets have the approximate vitamine content of a fresh yeast cake.

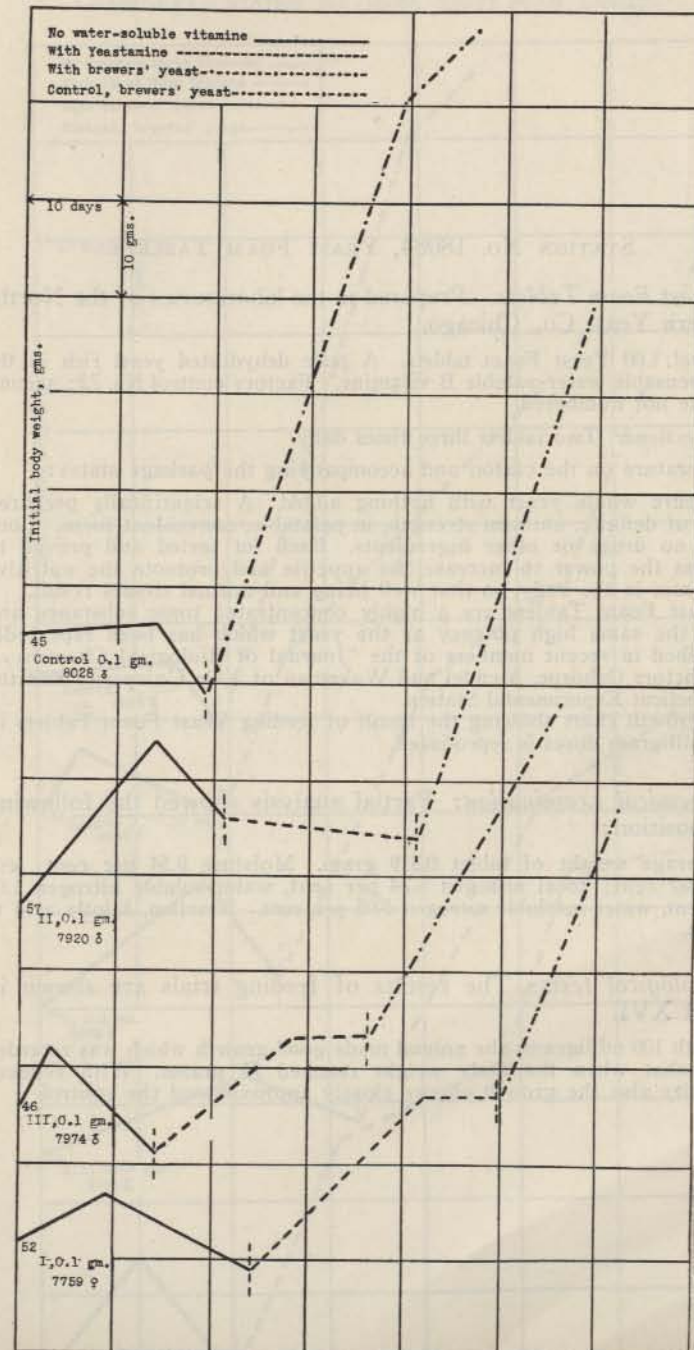
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.239 gram. Moisture 2.85 per cent; ash 13.65 per cent; total nitrogen 2.70 per cent, water-soluble nitrogen 0.79 per cent, water-insoluble nitrogen 1.91 per cent. Sugar present. Reaction faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XV.

In Trials I and III growth was secured but not maintained throughout the experimental period, but in Trial II the animal declined. In any case the curves show that the preparation is inferior to the control product.

CHART XV. STATION No. 18074, NORWICH YEASTAMINE.



STATION No. 18084, YEAST FOAM TABLETS.

Yeast Foam Tablets. Prepared in the laboratories of the Northwestern Yeast Co., Chicago.

Label: 60 Yeast Foam tablets. A pure dehydrated yeast rich in the indispensable water-soluble B vitamine. Factory control No. 72; second sample not numbered.

Directions: Two tablets three times daily.

Literature on the carton and accompanying the package states:

A pure whole yeast with nothing added. A scientifically prepared yeast of definite, uniform strength, in palatable, convenient form. Contains no drugs or other ingredients. Each lot tested and proved to possess the power to increase the appetite and promote the nutritive processes in the body, so that well being and normal tissues result.

Yeast Foam Tablets are a highly concentrated tonic substance and have the same high potency as the yeast which has been repeatedly described in recent numbers of the "Journal of Biological Chemistry," by Doctors Osborne, Mendel and Wakeman of Yale University and the Connecticut Experimental Station.

A growth chart showing the result of feeding Yeast Foam Tablets in 200 milligram doses is reproduced.

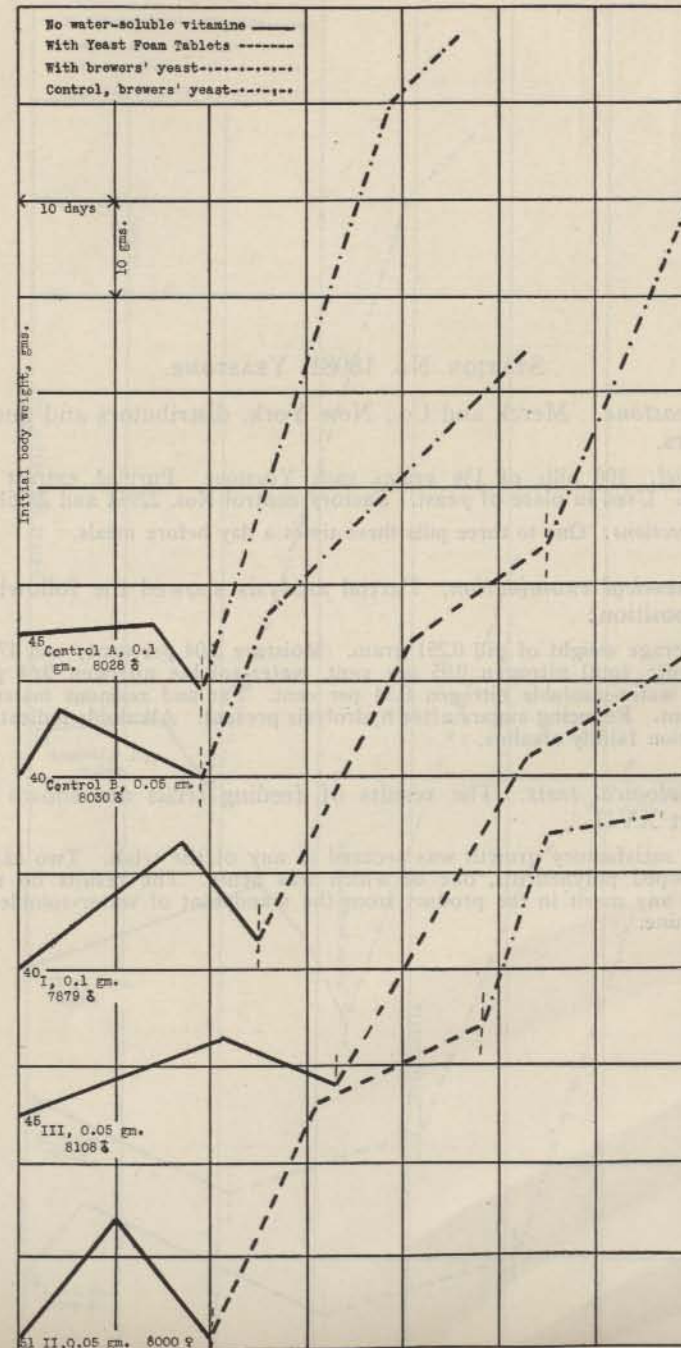
Chemical examination: Partial analysis showed the following composition:

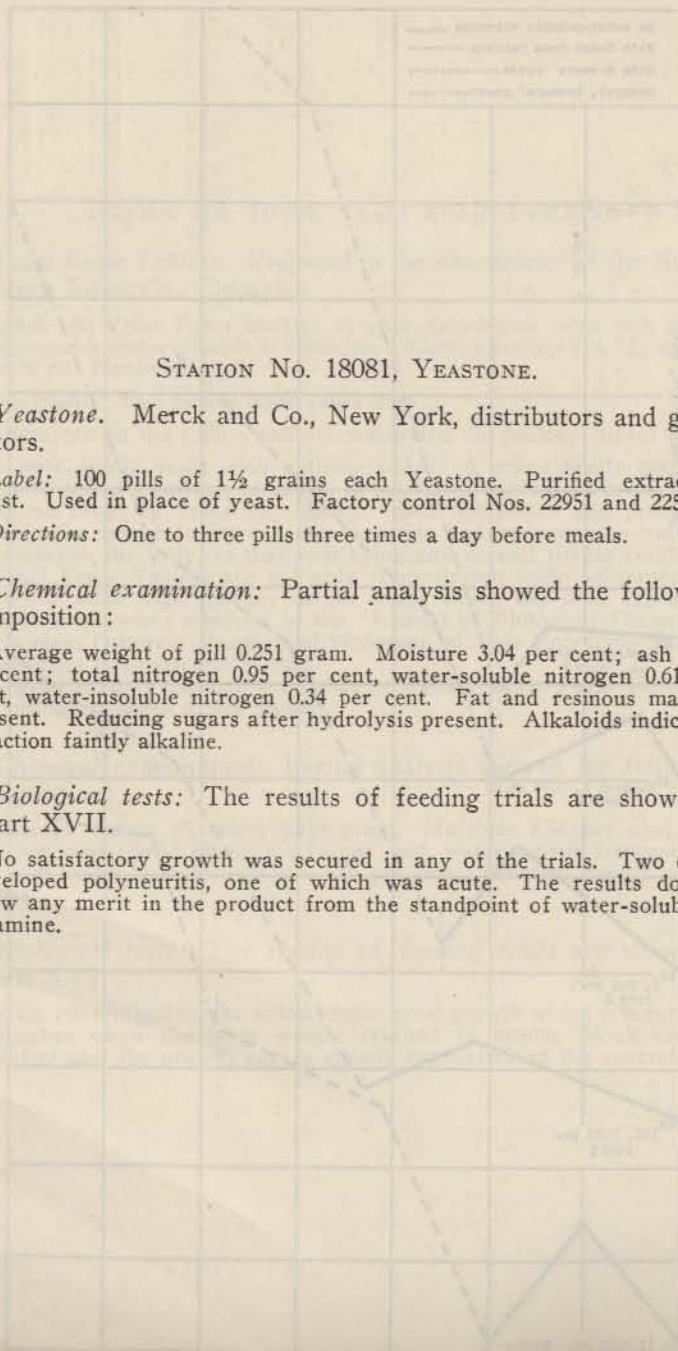
Average weight of tablet 0.519 gram. Moisture 8.54 per cent; ash 5.52 per cent; total nitrogen 6.74 per cent, water-soluble nitrogen 1.69 per cent, water-insoluble nitrogen 5.05 per cent. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XVI.

With 100 milligrams the animal made good growth which was retarded somewhat when the body weight reached 75 grams. With reduced quantity also the growth curves closely approximated the control.

CHART XVI. STATION No. 18084, YEAST FOAM TABLETS.





STATION No. 18081, YEASTONE.

Yeastone. Merck and Co., New York, distributors and guarantors.

Label: 100 pills of $1\frac{1}{2}$ grains each Yeastone. Purified extract of yeast. Used in place of yeast. Factory control Nos. 22951 and 22561.

Directions: One to three pills three times a day before meals.

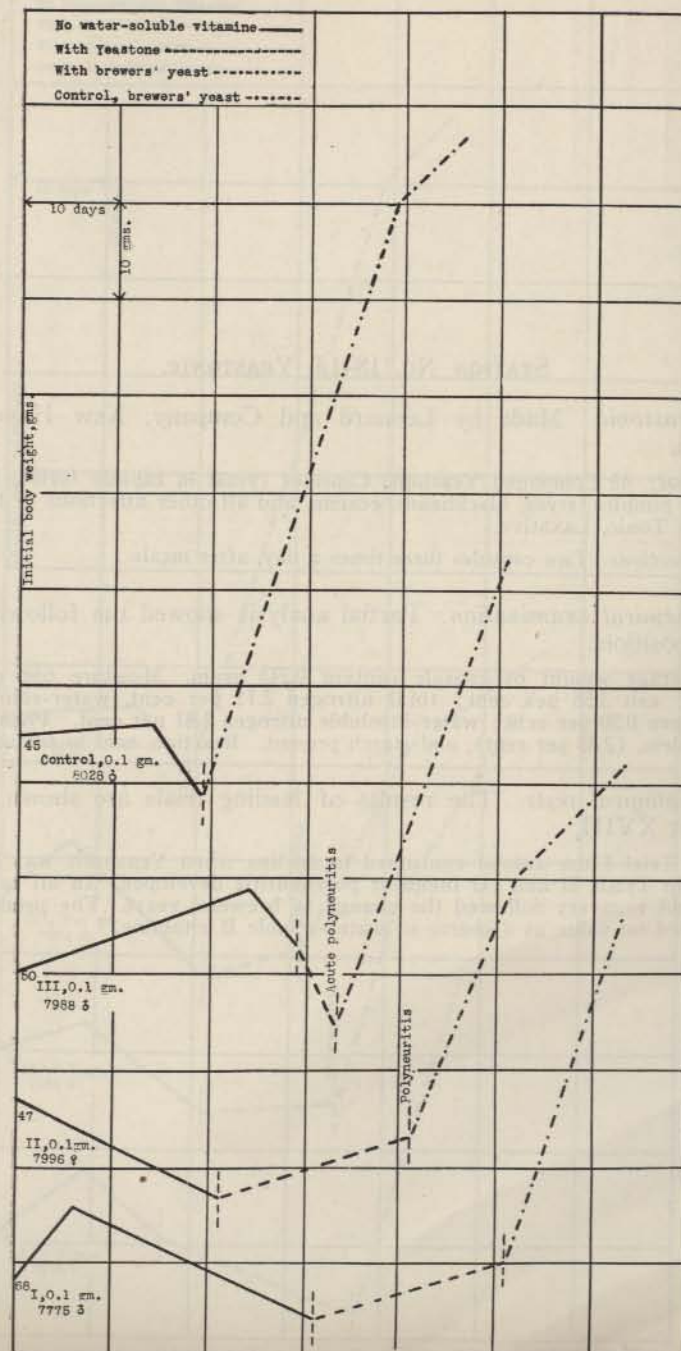
Chemical examination: Partial analysis showed the following composition:

Average weight of pill 0.251 gram. Moisture 3.04 per cent; ash 17.14 per cent; total nitrogen 0.95 per cent, water-soluble nitrogen 0.61 per cent, water-insoluble nitrogen 0.34 per cent. Fat and resinous material present. Reducing sugars after hydrolysis present. Alkaloids indicated. Reaction faintly alkaline.

Biological tests: The results of feeding trials are shown in Chart XVII.

No satisfactory growth was secured in any of the trials. Two cases developed polyneuritis, one of which was acute. The results do not show any merit in the product from the standpoint of water-soluble B vitamine.

CHART XVII. STATION No. 18081, YEASTONE.



STATION No. 18413, YEASTONIC.

Yeastonic. Made by Leonard and Company, New Haven, Conn.

Label: 45 Compound Yeastonic Capsules (yeast in capsule form), for boils, pimples, styes, blackheads, eczema and all other affections of the skin. Tonic, Laxative.

Directions: Two capsules three times a day, after meals.

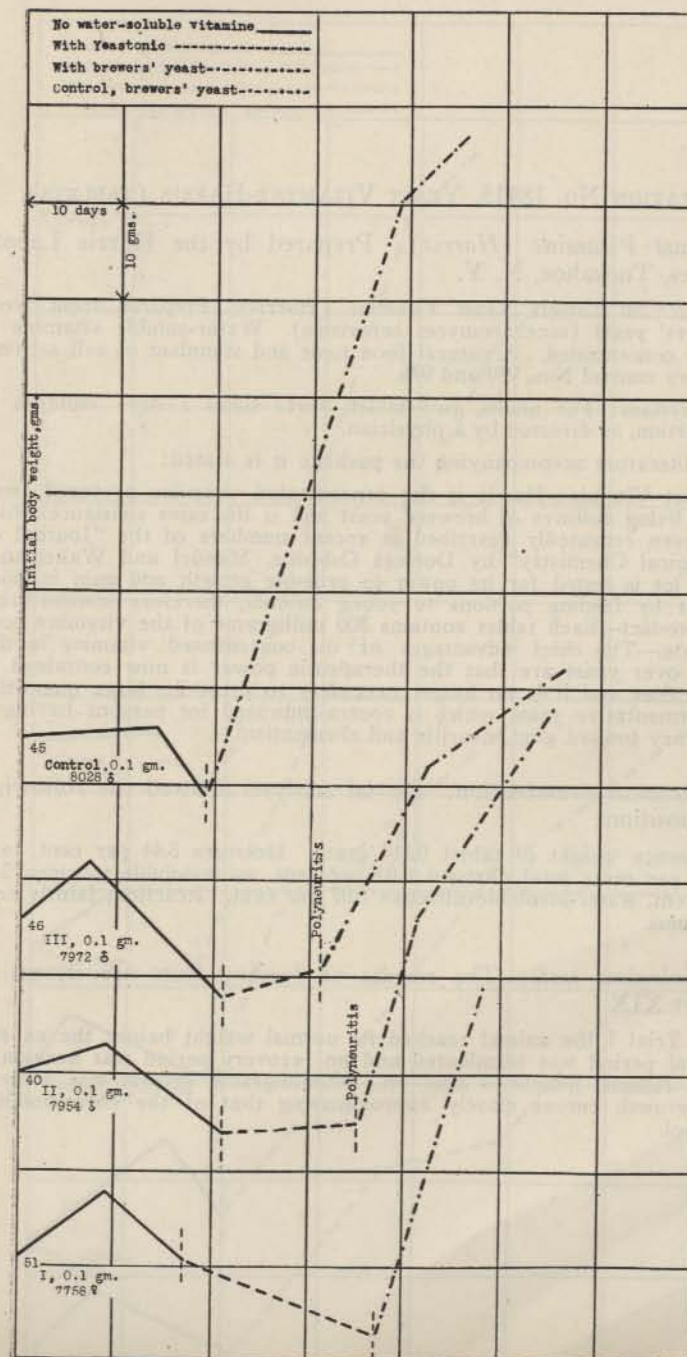
Chemical examination: Partial analysis showed the following composition:

Average weight of capsule content 0.243 gram. Moisture 6.96 per cent; ash 3.58 per cent; total nitrogen 2.11 per cent, water-soluble nitrogen 0.30 per cent; water-insoluble nitrogen 1.81 per cent. Phenolphthalein, (2.38 per cent), and starch present. Reaction, acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XVIII.

In Trial I the animal continued to decline when Yeastonic was fed and in Trials II and III incipient polyneuritis developed. In all cases prompt recovery followed the change to brewers' yeast. The product showed no value as a source of water-soluble B vitamin.

CHART XVIII. STATION No. 18413, YEASTONIC.



STATION No. 18415, YEAST VITAMINE-HARRIS (TABLETS).

Yeast Vitamine (Harris). Prepared by the Harris Laboratories, Tuckahoe, N. Y.

Label: 50 Tablets Yeast Vitamine (Harris). Prepared from fresh brewers' yeast (*saccharomyces cerevisiae*). Water-soluble vitamine B highly concentrated. A natural food tonic and stimulant of cell activity. Factory control Nos. 950 and 976.

Directions: For adults, two tablets three times a day; children in proportion, as directed by a physician.

In literature accompanying the package it is stated:

Yeast Vitamine-Harris is the concentrated vitamine prepared from fresh living cultures of brewers' yeast and is the same substance which has been repeatedly described in recent numbers of the "Journal of Biological Chemistry" by Doctors Osborne, Mendel and Wakeman—Each lot is tested for its power to promote growth and gain in body weight by feeding portions to young animals, therefore standardizing the product—Each tablet contains 200 milligrams of the vitamine concentrate.—The chief advantages of the concentrated vitamine in this form over yeast are that the therapeutic power is now contained in small dose and it is no longer necessary to prescribe large quantities of fermentative yeast which is contra-indicated for persons having a tendency toward gout, neuritis and rheumatism.

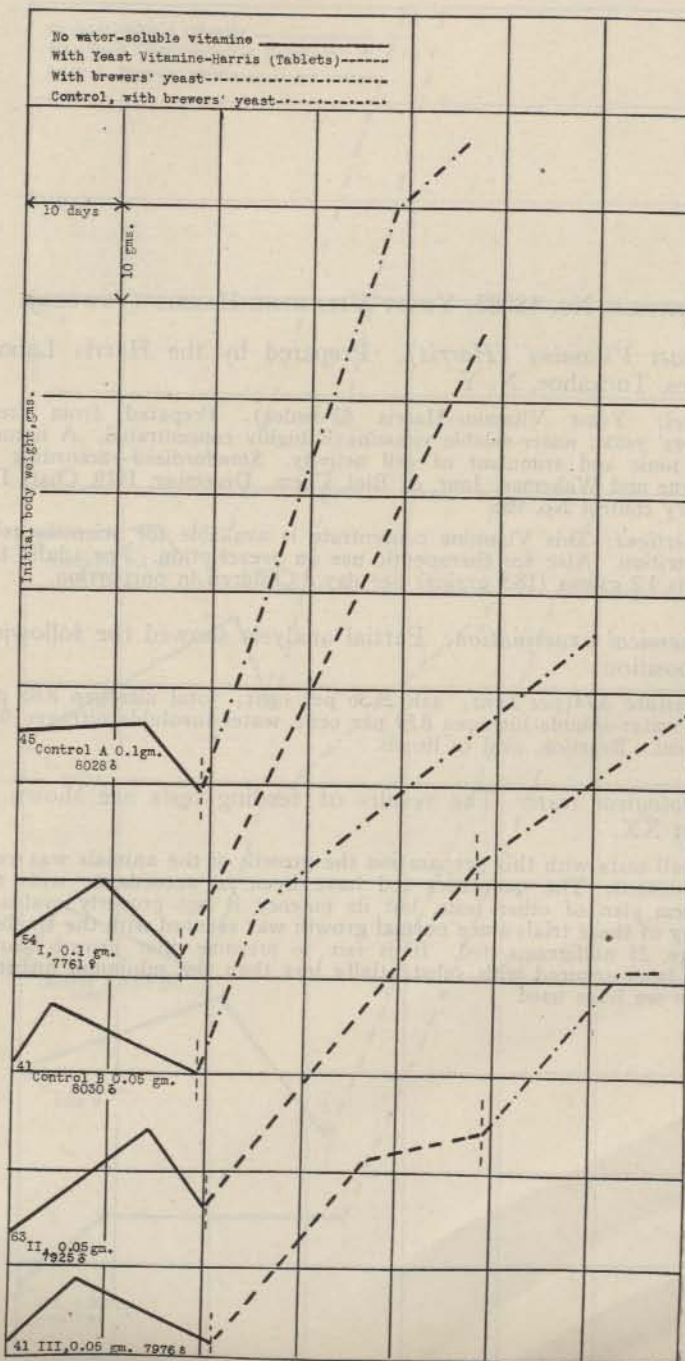
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.514 gram. Moisture 3.44 per cent; ash 13.58 per cent; total nitrogen 6.03 per cent, water-soluble nitrogen 5.96 per cent, water-insoluble nitrogen 0.07 per cent. Reaction, faintly acid to litmus.

Biological tests: The results of feeding tests are shown in Chart XIX.

In Trial I the animal reached its normal weight before the experimental period was terminated and no recovery period was necessary. With reduced quantities also, viz., 50 milligrams, growth was secured, the growth curves closely approximating that of the corresponding control.

CHART XIX. STATION No. 18415, YEAST VITAMINE-HARRIS (TABLETS).



STATION No. 18085, YEAST VITAMINE-HARRIS (POWDER).

Yeast Vitamine (Harris). Prepared by the Harris Laboratories, Tuckahoe, N. Y.

Label: Yeast Vitamine-Harris (Powder). Prepared from fresh brewers' yeast, water-soluble vitamine B highly concentrated. A natural food tonic and stimulant of cell activity. *Standardized*—according to Osborne and Wakeman, Jour. of Biol. Chem., December, 1919, Chart III. Factory control No. 985.

Directions: This Vitamine concentrate is available for scientific tests in nutrition. Also for therapeutic use on prescription. For adults the dose is 1.2 grams (18.5 grains) per day. Children in proportion.

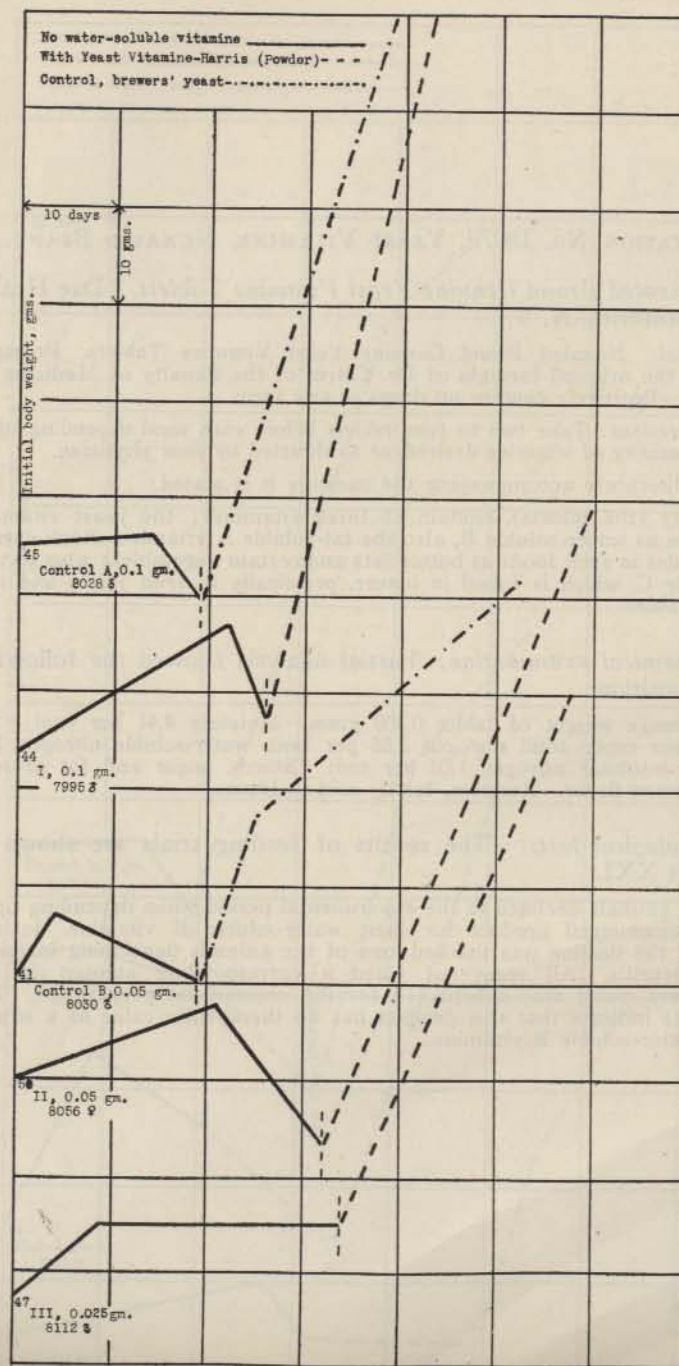
Chemical examination: Partial analysis showed the following composition:

Moisture 3.74 per cent; ash 25.36 per cent; total nitrogen 8.85 per cent, water-soluble nitrogen 8.59 per cent, water-insoluble nitrogen 0.26 per cent. Reaction, acid to litmus.

Biological tests: The results of feeding tests are shown in Chart XX.

In all tests with this preparation the growth of the animals was very conspicuous. The quantities fed have been in accordance with the uniform plan of other tests, but its potency is not properly evaluated in any of these trials since normal growth was secured with the smallest dosage, 25 milligrams, fed. It is fair to presume that growth would have been secured with substantially less than the minimum quantity which we have used.

CHART XX. STATION No. 18085, YEAST VITAMINE-HARRIS (POWDER).



STATION No. 18078, YEAST VITAMINE, NUXATED BRAND.

Nuxated Brand Genuine Yeast Vitamine Tablets. Dae Health Laboratories, N. Y.

Label: Nuxated Brand Genuine Yeast Vitamine Tablets. Prepared from the original formula of Dr. Catrin of the Faculty of Medicine of Paris—Positively contain no drugs in any form.

Directions: Take two to four tablets before each meal depending upon the quantity of vitamine desired, or as directed by your physician.

In literature accompanying the package it is stated:

They (the tablets), contain all three vitamines; the yeast vitamine known as water-soluble B, also the fat-soluble A vitamine which nature provides in such foods as butter fats and certain vegetables; also water-soluble C, which is found in nature, principally in fruit juices and raw vegetables.

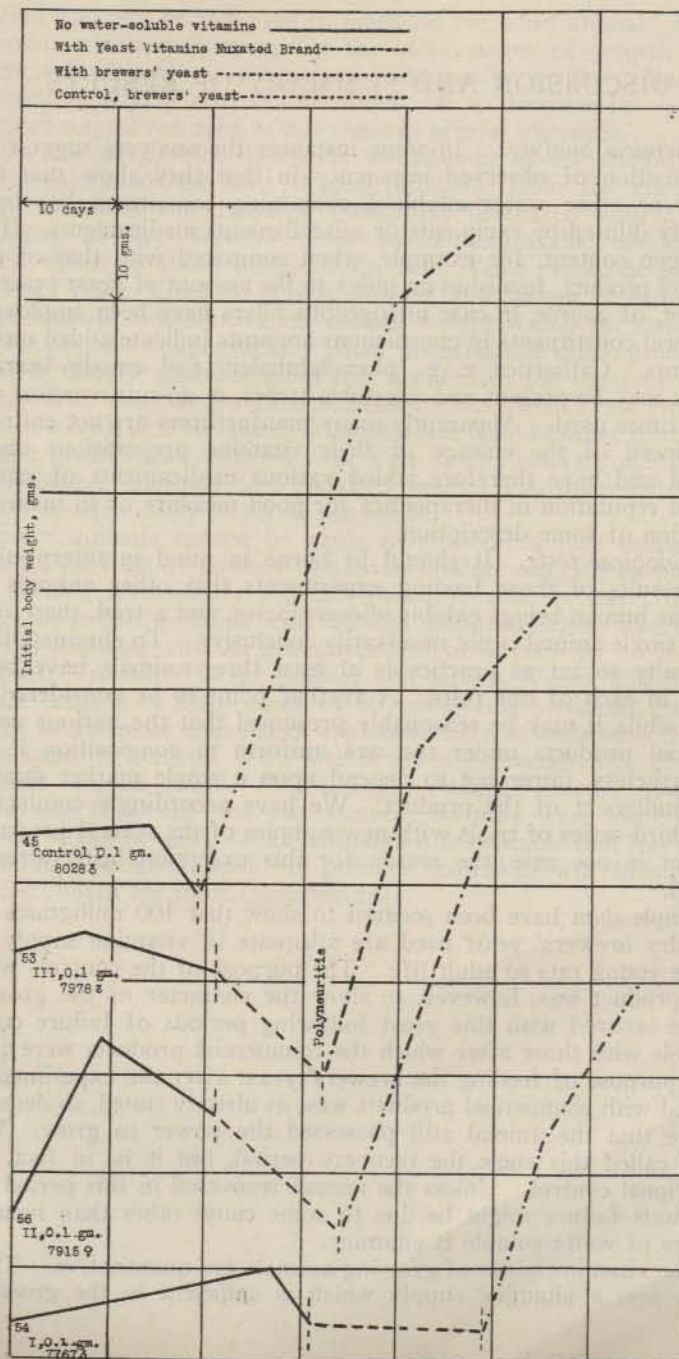
Chemical examination: Partial analysis showed the following composition:

Average weight of tablet 0.308 gram. Moisture 4.41 per cent; ash 4.19 per cent; total nitrogen 2.86 per cent, water-soluble nitrogen 1.84 water-insoluble nitrogen 1.02 per cent. Starch, sugar and fat present. Cinnamon flavor. Reaction, faintly acid to litmus.

Biological tests: The results of feeding trials are shown in Chart XXI.

All animals declined in the experimental period when depending upon this commercial product for their water-soluble B vitamine. In two cases the decline was marked, one of the animals developing incipient polyneuritis. All recovered when a corresponding amount of the brewers' yeast was substituted for the commercial preparation. The results indicate that this product has no therapeutic value as a source of water-soluble B vitamine.

CHART XXI. STATION No. 18078, YEAST VITAMINE NUXATED BRAND.



DISCUSSION AND SUMMARY OF RESULTS.

Chemical analyses. In some instances the analyses suggest an explanation of observed impotency in that they show that the yeast or other water-soluble B-containing constituent has been largely diluted by excipients or miscellaneous medicaments. The nitrogen content, for example, when compared with that of the control product, furnishes an index to the amount of yeast present, except, of course, in case nitrogenous fillers have been employed. Mineral constituents in conspicuous amounts indicate added medicaments. Cathartics, e. g., phenolphthalein and emodin-bearing drugs may be present and vegetable tonics, e. g., nux vomica, are sometimes used. Apparently many manufacturers are not entirely convinced of the efficacy of their vitamine preparations unassisted and have therefore added various medicaments of established reputation in therapeutics for good measure or to insure a reaction of some description.

Biological tests. It should be borne in mind in interpreting the results of these feeding experiments that other animals as well as human beings exhibit idiosyncracies, and a trial, therefore, on a single animal is not necessarily conclusive. To eliminate this difficulty so far as practicable at least three animals have been used in each of our tests. A further point to be considered is that while it may be reasonably presumed that the various commercial products under test are uniform in composition it is, nevertheless, fairer not to depend upon a single market sample for judgment of the product. We have accordingly conducted the third series of trials with new samples of the several products except in one case, the reason for this exception being already noted.

Ample data have been secured to show that 100 milligrams of the dry brewers' yeast used are adequate in vitamine supply to bring young rats to adult life. The purpose of the controls with this product was, however, to show the character of the growth curve secured with this yeast following periods of failure comparable with those after which the commercial products were fed. The purpose of feeding the brewers' yeast after the experimental period with commercial products was, as already stated, to demonstrate that the animal still possessed the power to grow. We have called this stage the recovery period, but it is, in fact, an additional control. Unless the animal recovered in this period its previous failure might be due to some cause other than insufficiency of water-soluble B vitamine.

The vitamine needs of growing animals are quantitative. That is to say, a vitamine supply which is sufficient in the growing

period may not be sufficient to maintain the adult animal; or an amount which is adequate in the early stages of growth may become inadequate as the animal increases in weight. Thus, in the accompanying charts, indications of a decrease in rate of growth may be referred to this cause in several instances.

For the purpose of this study the potency of the several products examined has been judged primarily from the effect of daily doses of one hundred milligrams compared with a like quantity of dry brewers' yeast under comparable conditions. Such doses of three preparations, viz., Yeast Vitamine-Harris tablets, Yeast Vitamine-Harris powder and Vegex brought the experimental animals to their normal weight within the duration of the period of experiment. Other preparations which produced growth closely approximating that secured in the controls were Cerevisine, Yeast Foam Tablets, Merck's Medicinal Yeast (tablets and powder), and Metagen. Maintenance, or indifferent or inconsistent growth was obtained with Vita Zest, Fleischmann's yeast, Yeastamine, Vitamon and Ironized yeast. The other products failed conspicuously in all of our trials.

Since animals cannot be made to grow at a rate exceeding normal, the limit of potency of a given product can only be judged by feeding increasingly reduced quantities and we have, therefore, made further trials with reduced dosages in cases where the results obtained with 0.1 gram appeared to warrant it.

Yeast Vitamine-Harris, powder and tablets, Vegex and Yeast Foam Tablets in daily doses of 50 milligrams produced growth which exceeded or equalled or approximated that secured with the corresponding control. With further reduced quantity, viz., 25 milligrams, Vegex failed. With Yeast-Vitamine-Harris, powder, growth at a normal rate was secured; no tests were made with smaller doses of this product, although it is probable that less than 25 milligrams would suffice to promote normal growth during the period chosen for these experiments.

The Ryder Printing House, New Haven, Conn.