

CHANGES OCCURRING IN MILK POWDER SUBJECTED  
TO GAMMA RAYING

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This work relates to an investigation of organoleptic changes occurring in milk powder subjected to irradiation and also to changes in the total content of bacteria and in the nutritive value (content of vitamins B).

Full powdered milk samples from various dairies were examined. Milk was irradiated with doses from  $3 \times 10^4$  rads to  $100 \times 10^4$  rads (1 Mrad) in a source C-60 having an activeness of 4000 curie and output of  $3 \times 10^5$  rads/hr.

The effect of various doses of rays on the organoleptic properties of full milk powder was tested and, under the circumstances in which the testing was carried out, a dose of  $4.5 \times 10^4$  rads was found to be the threshold value causing still no changes in milk powder taste. The TBA value was the same as for the control sample (not irradiated).

$6 \times 10^4$  rads were accepted as the threshold dose for full milk by Glew<sup>1</sup>, and  $5 \times 10^4$  by Lea. Both these doses are only slightly higher than those proposed by the author. It is possible that the differences are due to different criteria of evaluating the organoleptic values of the milk powder, or differences in the chemical composition of milk resulting from different races, feed, etc.

Further experience concerning the effect of rays on the preservation of the total bacteria content in milk has shown that even the very small doses of the order of  $3 \times 10^4$  rads resulted in the absence of bacteria in the irradiated milk diluted  $10^3$ , until the third month of storage.

With larger doses of rays used, no bacteria were found in a  $10^3$  dilution of milk stored for 6 months. This means that bacteria in milk powder are more sensitive to the irradiation and therefore most of them are killed even with very small doses of rays. No data concerning the destruction of bacteria in milk powder submitted to irradiation are available in the literature. According to data quoted by Warseck<sup>3</sup>, a dose

of 0.1 to 0.75 Mrad is necessary to kill 99% of all the bacteria contained in liquid milk.

As regards data concerning the preservation of B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> and biotine in the irradiated powder, the losses in these vitamins were quite evident. Depending on the dose applied, they are 5 to 17% for thiamin, 3 to 16% for riboflavin and 2 to 9% for cobalamin (Vitamin B<sub>12</sub>).

No biotine losses in powdered milk irradiated with from  $3 \times 10^4$  to  $100 \times 10^4$  rads were found. There are only few works dealing with the effect of the ionizing rays on vitamins contained in full powdered milk. According to Ziporin<sup>4</sup>, thiamin and riboflavin were not destructively affected by irradiation. Jeghiazarov<sup>5</sup> has also reported the radio-resistant behaviour of thiamin in milk powder. No data concerning the behaviour of cobalamin and biotine in milk powder subjected to irradiation are available. According to our investigations, certain, very small losses of vitamins B<sub>1</sub>, B<sub>2</sub> and B<sub>12</sub> in milk powder occur as a results of irradiation. The differences between the data quoted by the above mentioned authors and those obtained by us and concerning the destructive effect of irradiation on thiamin and riboflavin contained in full powder milk, are presumably due to the application of somewhat different methods of determining B<sub>1</sub>, and B<sub>2</sub> and the chemical composition of milk powder or, presumably, also the time for which sample was irradiated as well as its size and packing.

## CONCLUSIONS

1. Under our test conditions, the dose of  $4.5 \times 10^4$  rads is proposed as the threshold dose for full powdered milk.
2. It has been found that the irradiation with small doses results in a considerable reduction of the total amount of bacteria in milk powder.
3. Vitamin B<sub>1</sub>, B<sub>2</sub> and B<sub>12</sub> losses have been observed in the irradiated full milk powder, while biotine was resistant to the doses applied.

## LITERATURE

1. G. Glew: Some effects of ionising radiations on liquid whole milk and whey protein (Food irradiation conference, Harvell, England, November, 1958)
2. C. S. Lea: Int. J. Appl. Rad. Isot. 692 (1952)
3. M. Warseck: Milchwia, 15 115 (1960)
4. Z. Z. Ziporin, H. F. Kraybill, H. Y. Thach: J. Nutr. 63 201 (1957)
5. G. M. Jeghiazarow: Wap. Pit. 4 54, 1960.

## Streszczenie

ZMIANY W MLEKU PEŁNYM W PROSZKU POD WPŁYWEM  
PROMIENIOWANIA GAMMA

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Zbadano zmiany organoleptyczne zachodzące w mleku i mleku pełnym w proszku pod wpływem różnych dawek promieniowania gamma, jak również zmiany ogólnej ilości bakterii oraz zawartości witaminy B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> i biotyny. Badania wykazały, że:

- dawka progowa dla mleka pełnego w proszku wynosi  $4,5 \times 10^4$  radów,
- w napromieniowanym mleku pełnym w proszku następuje obniżenie ogólnej ilości bakterii,
- napromieniowanie mleka pełnego w proszku prowadzi do strat witaminy B<sub>1</sub>, B<sub>2</sub> i B<sub>12</sub>. Biotyna nie podlega wpływowi promieniowania.

## Résumé

CHANGEMENTS PROVOQUÉS DANS LE LAIT ENTIER EN POUDRE  
SOUS L'ACTION DES RAYONS GAMMA

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Le travail a pour objet l'évaluation des modifications organoleptique du lait entier et du lait en poudre sous l'influence des rayons gamma, à des doses différentes, et la mise en évidence des changements concernant le nombre global des bactéries et les changements quantitatifs des vitamines: B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> et biotine.

Les expériences qui ont été effectuées prouvent que:

1. La dose de seuil pour le lait entier en poudre dans des conditions d'essais est égale à  $4,5 \times 10^4$  rads.
2. Dans le lait entier en poudre irradié on a noté une réduction du nombre global des bactéries.
3. Dans le lait entier en poudre irradié on a constaté des pertes en vitamines B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub>. La biotine s'est montrée radio-résistante quelque soit la valeur de la dose de l'irradiation.

## Summary

CHANGES OCCURRING IN MILK POWDER SUBJECTED TO  
GAMMA RAYS

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The object of this work is to evaluate the organoleptic alterations in whole milk and milk powders under the influence of various doses of gamma rays, and to show the changes occurring in the total number of bacteria as well as the quantitative changes in vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> and biotin contents.

The experiments carried out prove that:

1. The threshold dose for whole milk powders in the conditions of the experiment is of  $4,5 \times 10^4$  rads.
2. A decrease of the total number of bacteria was noted in irradiated whole milk powder.
3. Losses in vitamin B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> were noted in irradiated whole milk powders. Biotine proved to be radiation-resistant whatever be the value of the irradiation dose.

### Zusammenfassung

## VERÄNDERUNGEN DES VOLLMILCHPULVERS UNTER DER EINWIRKUNG DER GAMMASTRAHLUNG

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Die Veränderungen der organoleptischen Eigenschaften der Milch und Vollmilch in Pulverform, unter der Einwirkung verschiedener Dosen von Gammastrahlen, die Veränderungen der Bakterien-Gesamtzahl sowie des mengenmässigen Verhaltens der Vitamine B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> und des Biotins wurden untersucht. Die Versuche ergaben:

Die Schwellendosis für Vollmilchpulver beträgt  $4,5 \times 10^4$  rad.

Im bestrahlten Vollmilchpulver ist eine Senkung der Bakteriengesamtzahl festgestellt worden.

Die Bestrahlung des Vollmilchpulvers führt zu Verlusten an Vitamin B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub>. Biotin erwies sich als strahlenbeständig.

### Резюме

## ИЗМЕНЕНИЯ В ЦЕЛЬНОМ СУХОМ МОЛОКЕ ПОД ВЛИЯНИЕМ ГАММА-ОБЛУЧЕНИЯ

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Исследовались органолептические изменения, происходящие в молоке и в цельном сухом молоке под влиянием различных доз гамма — облучения, а также изменения общего количества бактерий и содержания витаминов B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> и биотина.

Исследования показали, что:

— предельная доза гамма — облучения для цельного сухого молока составляет  $4,5 \times 10^4$  радий;

— в цельном сухом молоке, подвергнутом облучению, уменьшается общее количество бактерий;

— облучение цельного сухого молока вызывает потерю витаминов В<sub>1</sub>, В<sub>2</sub> и В<sub>12</sub>. Биотин не подвергается влиянию облучения.