PINSTECH/HPD-124

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ABSTRACT

Radiometric analysis of LUNCH SERVED AT PINSTECH CAFETERIA was carried out during the period from 1976 to 1984 by NaI (Tl) scintillation detector, high resolution Ge(Li) detector gamma spectrometry system and low level beta counter. K-40 and Sr-90 were the most prominent radionuclides normally detected in all the lunch samples. Other radionuclides were below the measurement limits of our counting set up. Assuming 5 days a week and 50 weeks a year it can be safely stated that intake of K-40 and Sr-90 through LUNCH taken at PINSTECH Cafeteria remains well below the respective ALI,s of these radionuclides.

1. INTRODUCTION

Radiometric analysis of Lunch Served at PINSTECH Cafeteria was started in 1976. The regime of analysis included gamma spectrometry of the samples followed by the radio-chemical analysis of the ashed samples for the separation and measurement of the beta emitting radionuclides of radiological significance to the population particularly Strontium-90 and Cesium-137. However, contents of Cs-137 were normally so low that it could not be detected and measured at our counting set up.

2. SAMPLING PROCEDURE

Two Lunch samples per month were collected for analysis from PINSTECH Cafeteria. The samples were first dry ashed at about 450°C for the removal of organic matrix. The ashing period was about sixteen hours. The ash was first analyzed by gamma spectrometry and then after radiochemical separation by beta counting.

3. RADIOMETRIC ANALYSES

3.1 Gamma Spectrometry

Gamma spectrometry was performed by a 3" x 3" NaI (Tl) scintillation detector and a co-axial Ge(Li) detector. The NaI(Tl) detector has a resolution of 84 Kev (FWHM) at 661 Kev and 128.8 Kev at 1460 Kev gamma lines and an efficiency of 44% for a point ^{137}Cs source placed at a distance of 25cm from the detector. The gamma spectra were analysed manually by comparing the integrated peak counts with the efficiency calibration plot. (1).

The Ge (Li) detector has a resolution of 1.84 Kev (FWHM) at 1332 Kev gamma line and an efficiency of 12.2% for 1332 Kev relative to the efficiency of a standard 3" x 3" NaI (Tl) scintillation detector. The spectra were analyzed by a PDP-11/05 computer based multichannel analyser (2).

3.2 Radiochemical Analysis

Radiochemical analysis of ashed samples was performed after gamma spectrometric measurement. Two different methods were used. In the first procedure, the sample was treated with fuming nitric acid, as a result calcium was separated from sample solution Radium, Lead and Barium were removed by precipitation as chromate. Ferric hydroxide was added to remove residual radioactive contaminants. The pure strontium-90 solution was stored to allow the growth of Yttrium-90. After two weeks interval, Yttrium was precipitated as hydroxide. The yttrium hydroxide was dissolved in water and finally precipitated with oxalic acid, filtered and mounted for beta counting (3). The chemical yield of yttrium ranged between 80 to 90%.

In the second procedure, the ashed samples were digested in nitric acid, yttrium-90 already in equilibrium with strontium-90 was extracted from the solution in to tri-n-butyl phosphate (TBP), back extracted into water from TBP, precipitated as hydroxide and converted to Oxalate for beta counting. The average yttrium recovery ranged between 80 to 95% (4).

4. EXPERIMENTAL

The data on the levels of concentration of K-40 and Sr-90 in the Lunch served at PINSTECH Cafeteria is recorded in tables one to nine and represented by histogram Nos. one to nine.

5. DISCUSSION

^{40}K a naturally occurring radionuclide present in the environment was the only gamma emitter detected in lunch samples. Its concentration ranged between 0.108 to 219.15 becquerel/meal with an average value of 26.18 Bq/meal throughout the reported period. Assuming 250 lunch taken at PINSTECH every year, total

annual intake of K-40 works out to be 6.5 x 10^3Bq which is much lower than the Annual Limit of intake (ALI) of K-40 i.e. 1x 10^7 Bq. (5). ^{137}Cs, a long lived gamma emitter could not however be detected in these samples as its concentration was too low to be detected and measured by our counting set-up.

Sr-90 a long lived beta emitter was present in almost every sample. The levels of concentration of Sr-90 varied from a fraction of a becquerel to a few becquerel/meal throughout the period under report, with total annual intake of 1.52 x 10^2 Bq which is much less than ALI (1 x 10^6 Bq) of this radionuclide (5).

A wide spread was observed in the concentration values of both the radionuclides. The variation may be attributed to deviation due to sampling and deviation due to analytical techniques.

6. CONCLUSION AND RECOMMENDATION

It can be concluded that Lunch served at PINSTECH Cafeteria contained very nominal amount of K-40 and Sr-90 which is much less than the ALI's of respective radionuclides as specified by International Commission on Radiological Protection (5). To improve the possibilities of true sample collection, it is recommended that samples be collected for five days in a month and preferrably for five consecutive days in the same week.

ACKNOWLEDGEMENT

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TABLE-1

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1976

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	37.84	-
Feb.	48.83	0.545
Mar.	20.94	0.808
Apr.	+	+
May	15.06	0.488
June	113.96	1.948
July	78.06	3.626
Aug.	11.51	-
Sep.	22.86	0.529
Oct.	42.77	0.959
Nov.	12.03	0.769
Dec.	22.09	-

- Below detection limit.

+ Sample not collected.

TABLE-2

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1977

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	15.02	0.120
Feb.	29.77	1.978
Mar.	10.93	0.864
Apr.	22.09	0.241
May	28.82	0.379
June	Not analyzed	0.147
Jul.	17.65	0.302
Aug.	19.06	0.150
Sep.	+	+
Oct.	24.87	-
Nov.	21.47	-
Dec.	32.62	0.895

- Below detection limit.

+ Sample not collected.

TABLE-3

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1978

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	25.38	-
Feb.	8.44	0.427
Mar.	21.83	0.329
Apr.	19.24	0.076
May	29.26	0.233
Jun.	20.09	0.451
Jul.	15.43	1.214
Aug.	28.12	3.419
Sep.	30.34	0.798
Oct.	38.11	0.429
Nov.	38.85	1.430
Dec.	58.46	1.621

- Below detection limit.

TABLE-4

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1979

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	Sample lost	-
Feb.	29.99	-
Mar.	11.95	0.572
Apr.	27.68	0.265
May	38.11	0.159
Jun.	0.906	0.180
Jul.	0.108	0.082
Aug.	+	+
Sep.	30.41	0.180
Oct.	29.23	0.127
Nov.	34.89	-
Dec.	35.26	-

- Below detection limit.

+ Sample not collected.

TABLE-5

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1980

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	16.06	0.123
Feb.	46.54	0.270
Mar.	3.49	0.081
Apr.	5.70	1.151
May	18.26	0.166
Jun.	14.02	0.220
Jul.	72.26	0.422
Aug.	14.82	0.376
Sep.	+	+
Oct.	16.16	0.107
Nov.	93.23	0.411
Dec.	25.10	0.260

+ Sample not collected.

TABLE-6

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1981

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	13.46	0.069
Feb.	10.30	-
Mar.	18.30	0.246
Apr.	19.26	-
May	4.29	-
Jun.	61.38	0.203
Jul.	+	+
Aug.	21.26	0.163
Sep.	9.14	2.945
Oct.	48.06	0.134
Nov.	39.99	0.203
Dec.	11.56	0.193

- Below detection limit.

+ Sample not collected.

TABLE-7

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1982

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	27.58	0.517
Feb.	30.89	-
Mar.	64.06	-
Apr.	98.79	0.579
May	16.67	0.118
Jun.	42.66	0.690
Jul.	+	+
Aug.	47.08	0.035
Sep.	22.71	0.414
Oct.	25.67	0.447
Nov.	219.15	0.300
Dec.	58.24	0.210

\- Below detection limit.

\+ Sample not collected.

TABLE-8

Average Concentration of ^{40}K and ^{90}Sr in Lunch samples Collected from PINSTECH Cafeteria During 1983

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	8.17	1.208
Feb.	4.91	0.694
Mar.	2.38	0.884
Apr.	8.43	0.659
May	1.46	0.392
Jun.	2.47	0.382
Jul.	+	+
Aug.	3.48	0.579
Sep.	8.82	0.285
Oct.	5.89	0.281
Nov.	3.41	0.325
Dec.	6.88	0.317

+ Sample not collected.

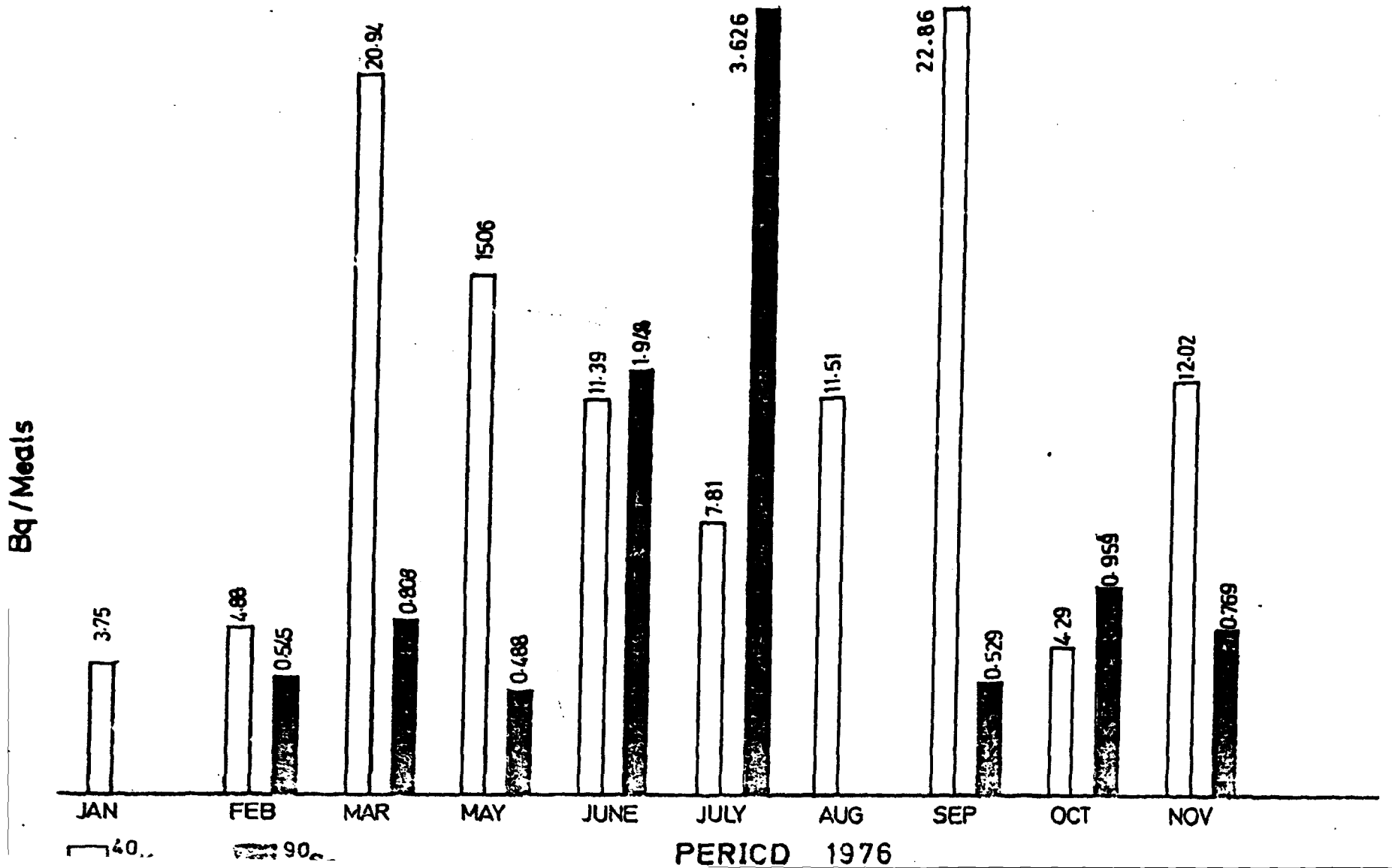
TABLE-9

Average Concentration of ^{40}K and ^{90}Sr in Lunch Samples Collected from PINSTECH Cafeteria During 1984

Period	Concentration Bq/Lunch	
	^{40}K	^{90}Sr
Jan.	6.05	1.468
Feb.	2.69	2.187
Mar.	5.75	0.659
Apr.	3.17	0.544
May	10.35	0.788
Jun.	+	+
Jul.	6.75	0.685
Aug.	7.65	0.320
Sep.	3.61	0.308
Oct.	5.05	0.569
Nov.	6.35	0.302
Dec.	4.04	0.464

+ Sample not collected.

AVERAGE CONCENTRATION OF ^{40}K & ^{90}Sr (Bq / MEAL) IN LUNCH SERVED AT PINSTECH CAFETERIA



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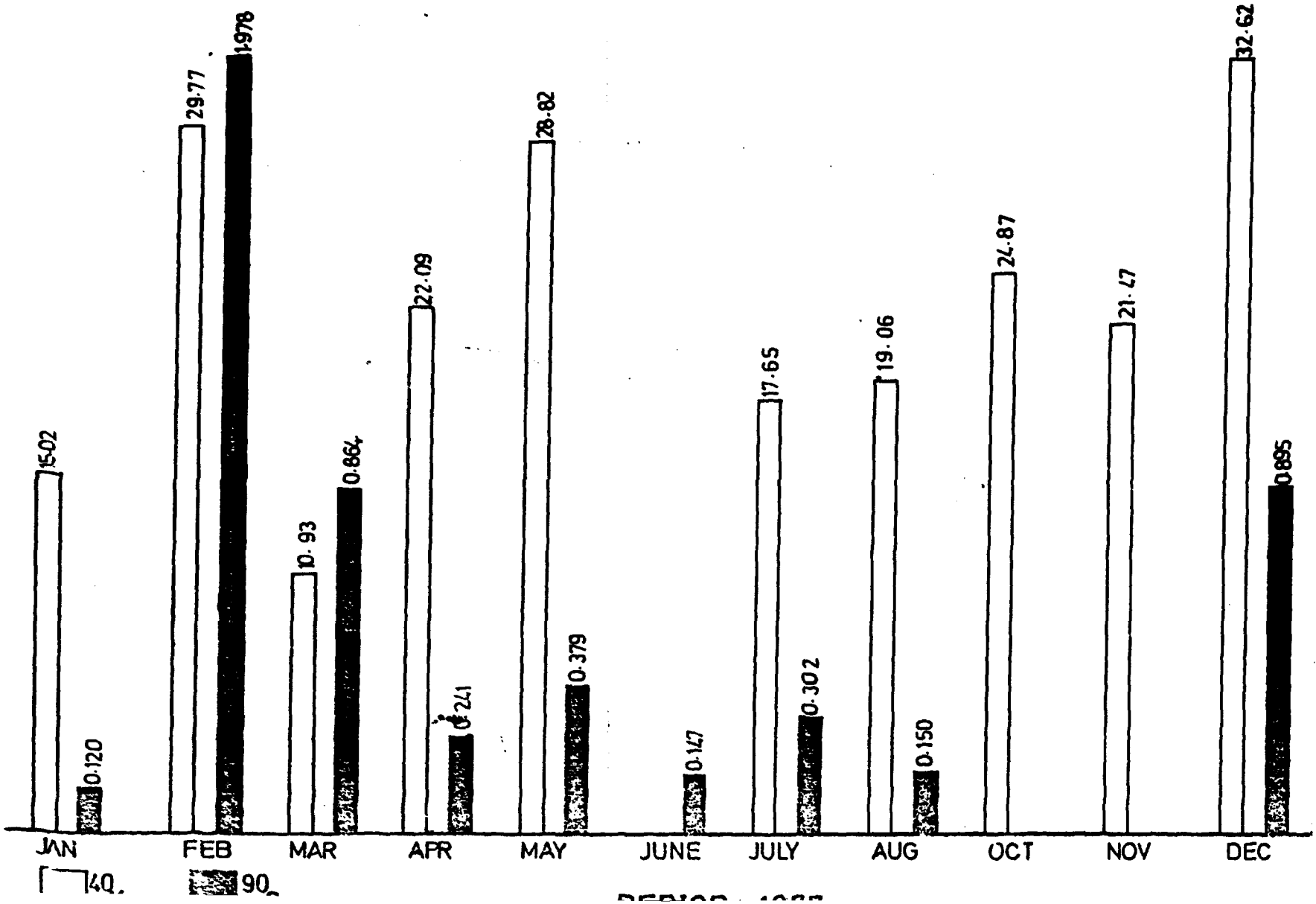

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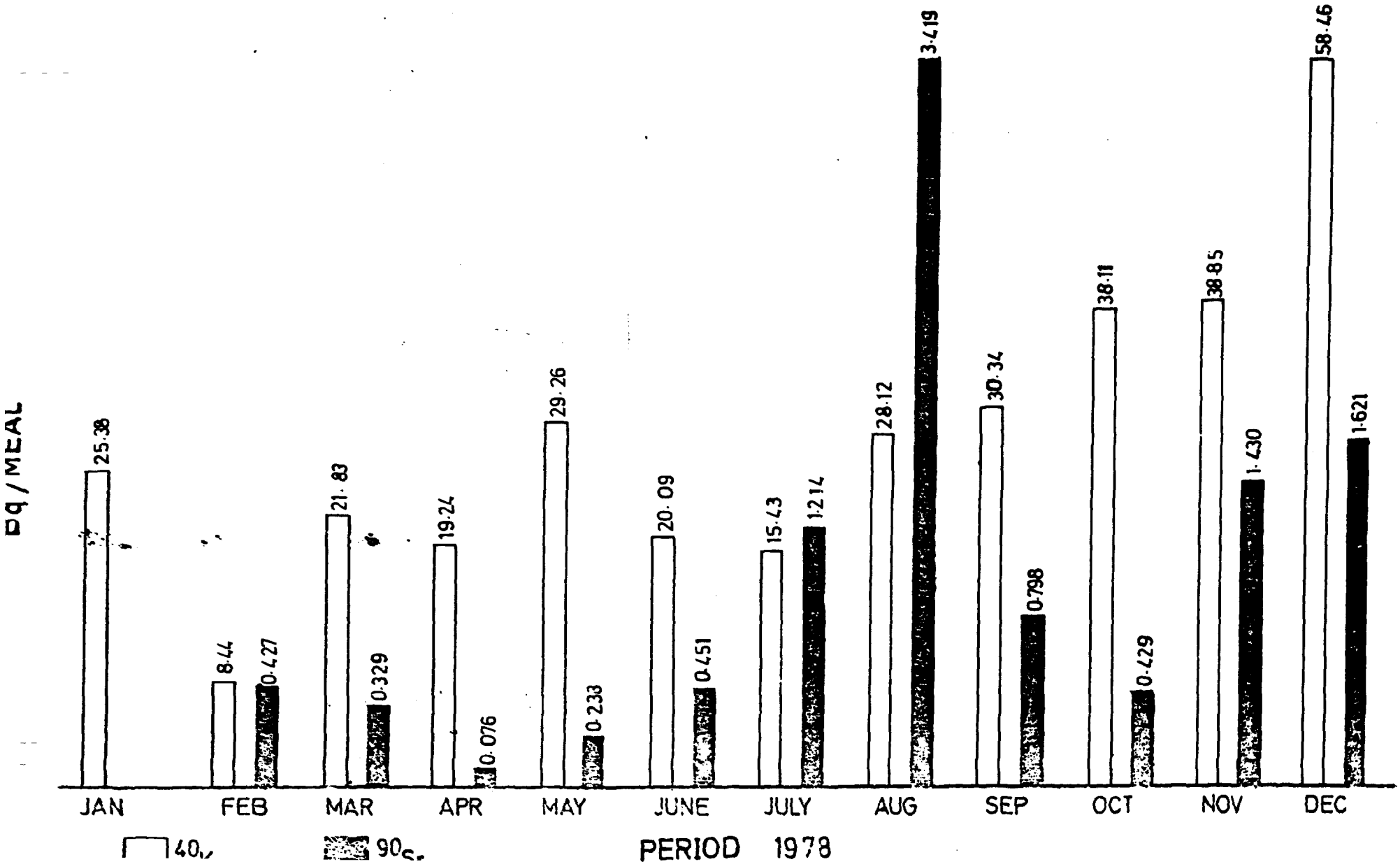

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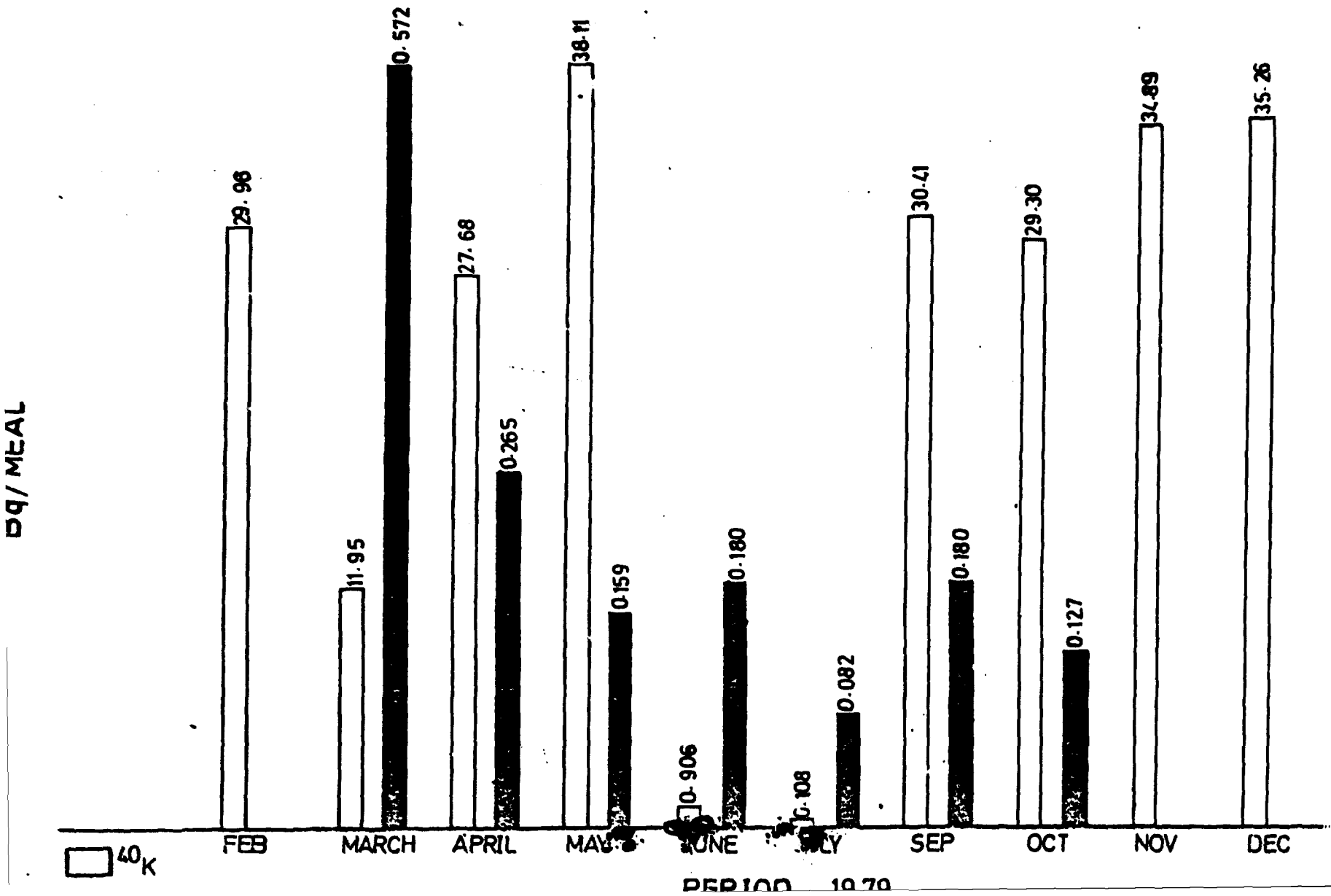

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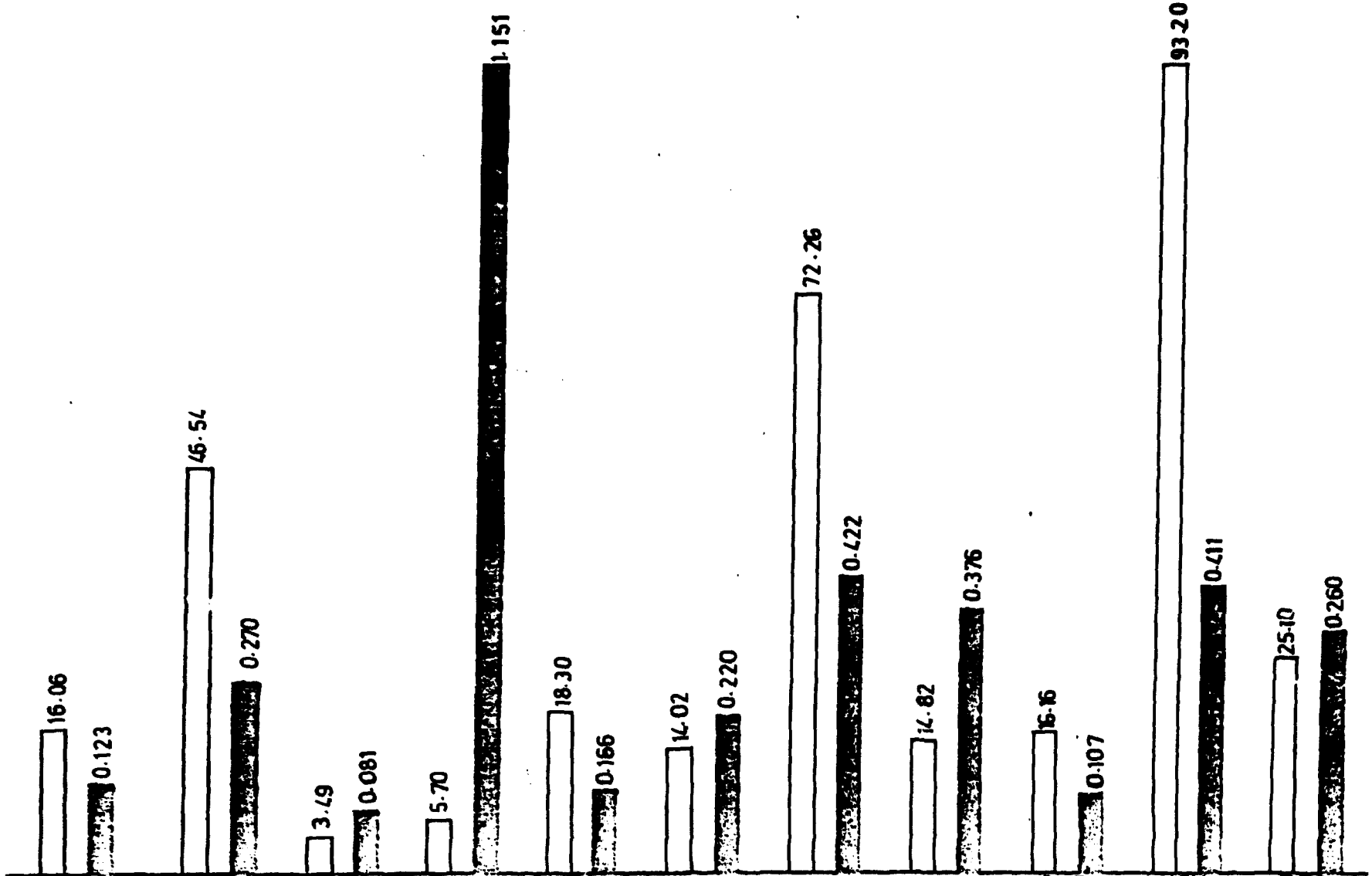

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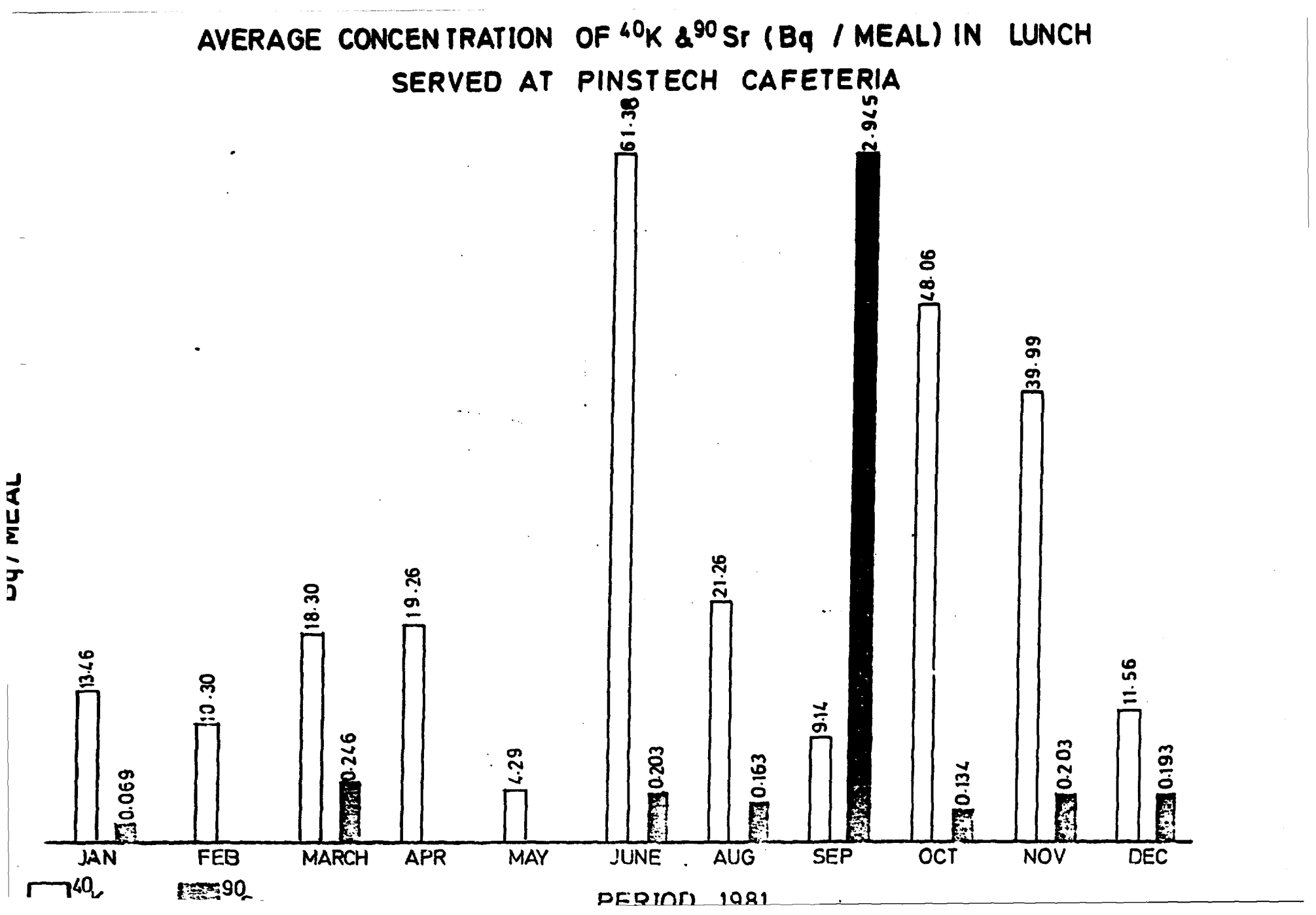

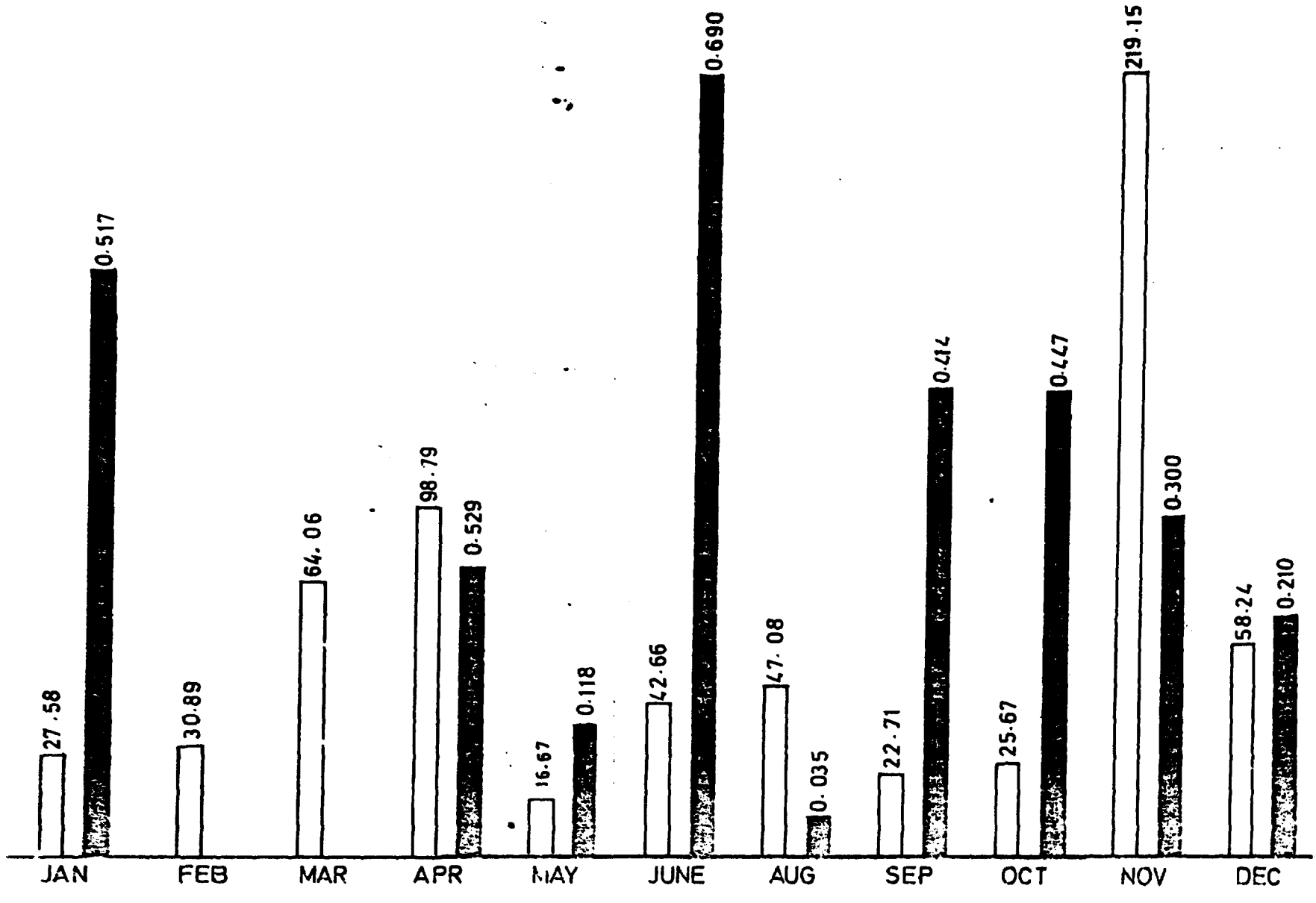
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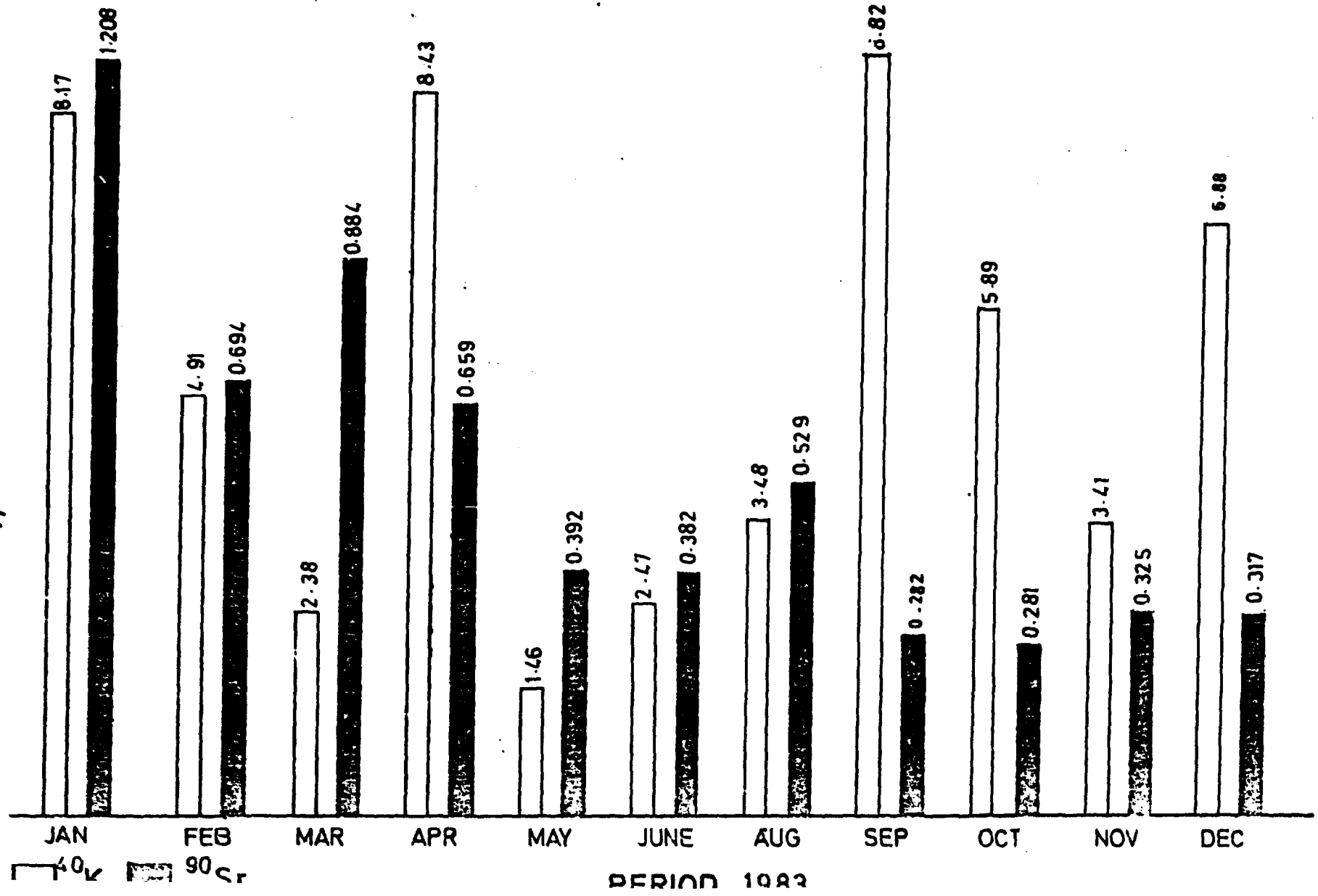

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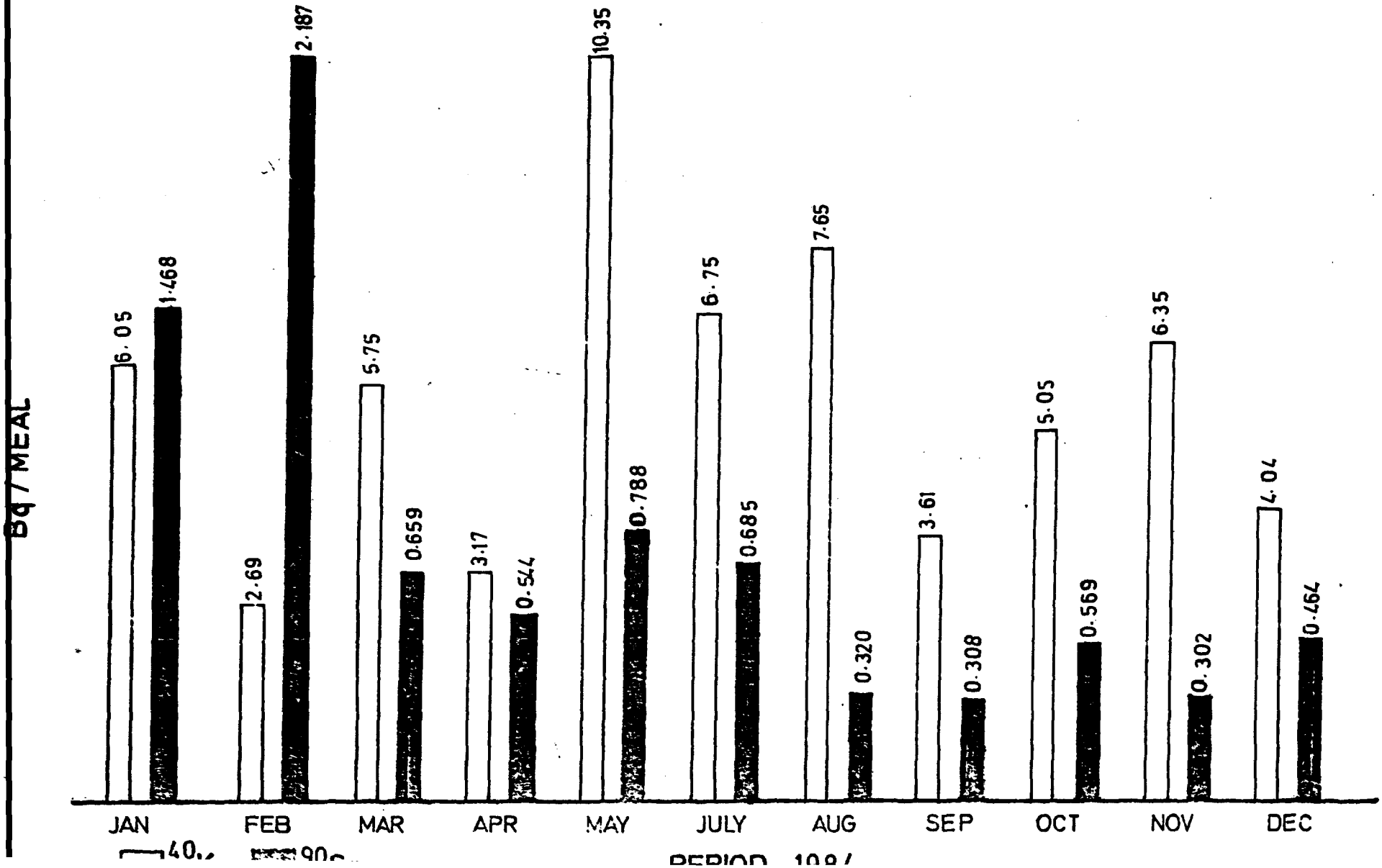

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