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Concentrated animal food

RCH PROGRAMME NO. 54
(STUDY OF MATERIAL DETERIORATION)

sponsored by
ADVANCED RESEARCH PROJECTS AGENCY (ARPA), U.S. DEPARTMENT OF DEFENSE

conducted by
APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND
under U.S. Army Contract DAJB 29-70-C-0086

with the cooperation of
MILITARY RESEARCH AND DEVELOPMENT CENTER (MRDC)

PRESERVED FOOD SERIES

REPORT NO. 4
CONCENTRATED ANIMAL FOOD

BY
KAEW NUALCHAWEE
WILLIAM G. PREWETT
PAKORN PAKARNSEREE
ENVIRONMENTAL AND ECOLOGICAL RESEARCH INSTITUTE

ASRCT, BANGKOK 1974
not for publication

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EXPOSURE TESTING (STUDY OF MATERIAL DETERIORATION)

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F O R E W O R D

The work reported herein is part of a research programme called "Exposure Testing", or "Study of Material Deterioration". This report presents the results obtained from the fourth withdrawal of the concentrated animal food exposed at Sakaerat's exposure testing site. It was originally scheduled for seven withdrawals altogether, but the animal food samples did not withstand the environment beyond the fourth withdrawal (which fell on 12 October 1972). Therefore this report concludes all the results obtained and is designated the "Final Report" of results of the concentrated animal food series. The programme was sponsored by the U.S. Advanced Research Projects Agency of the Office of the Secretary of Defense, under ARPA contract number DAJB 29-70-C-0086, Task 3-1. The establishment of the exposure testing facilities and performing of the programme by the Applied Scientific Research Corporation of Thailand was done in cooperation with the Military Research and Development Center (MRDC) and other RIG agencies for the benefit of the Royal Thai Armed Forces as a whole.

CONCENTRATED ANIMAL FOOD

By Kaew Nualchawee*, William G. Prewett*,
and Pakorn Pakarnseree*

SUMMARY

A number of concentrated animal food samples was supplied, by Charoen Phokphan Feed Mill Co. Ltd., through the Military Research and Development Center of the Supreme Command Headquarters, to the Exposure Testing Project for use as test specimens. The liaison personnel for MRDC were Col. Adulsuckdi Mitrabhuckdi, Maj. Sripan Vichapan, and Maj. Howard S. De Witt. The purpose of the test was to study the shelf life of the concentrated animal food stored under the environmental conditions of Sakaerat Experiment Station. The animal food in two different types of container and five different formulae was placed on the wooden floors of the wooden huts, built to simulate field depots. The two wooden huts are located in the cleared site, and at the jungle site. There is one wooden building, fitted with an air-conditioner to serve as a control room, located near the two aforementioned huts. Therefore conditions for exposure storage are specified as storage in cleared, and jungle sites, and in a control room (air-conditioned room).

INTRODUCTION

In rural areas, communication and transportation can be accomplished by foot and by use of animals. Roads and other means of transportation may not be possible because of many difficulties, especially funding problem. Because of the uses and versatility of animals, such as horses, asses, and mules, their existence of services in most army has been accepted and highly regarded. In order to keep the animals in good working conditions, and for better service, they should be fed with reasonable nutritional food. Realizing this fact the Military Research and Development Center has contracted a local firm to produce animal food for that

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purpose. In order to understand the rate of deterioration of the food or its shelf life, MRDC asked ASRCT, through its Environmental and Ecological Research Institute, to undertake exposure tests on animal food. To do this the project has set up different conditions for exposure, i.e. a shelter in the cleared site, a shelter in the jungle site, and an air-conditioned room.

This report presents the results of tests carried out before exposure and after the fourth withdrawal (which was the last withdrawal for the series). Samples of the fourth withdrawal were exposed from 12 May - 12 October 1972.

MATERIALS AND METHODS OF EXPOSURE

The concentrated animal food samples received for test specimens comprises five (5) formulae, each contained in both sealed plastic bags, and sewn laminated paper/plastic bags. Only formulae 1 and 5 in the laminated paper/plastic bags were selected to be test specimens. Details of composition of any one formula (as given by the company) are presented below.

Composition of food	Formula 1	Formula 2	Formula 3	Formula 4	Formula 5
Paddy rice, ground	+	+	+	+	+
Corn, ground	+	+	+	+	+
Rice bran	+	+	+	+	+
Soybean meal	+	+	+	+	+
Peanut meal	-	-	+	-	-
Fish meal	-	+	-	-	-
Dicalcium phosphate	+	+	+	+	-
Limestone	+	+	+	+	-
Salt	+	+	+	+	+
Mollasses	+	+	+	+	-
Fat	-	-	-	+	-
Premix	+	+	+	+	-
Ground bone (steamed)	-	-	-	-	+

Containers Two kinds of container were used in packaging, they were:

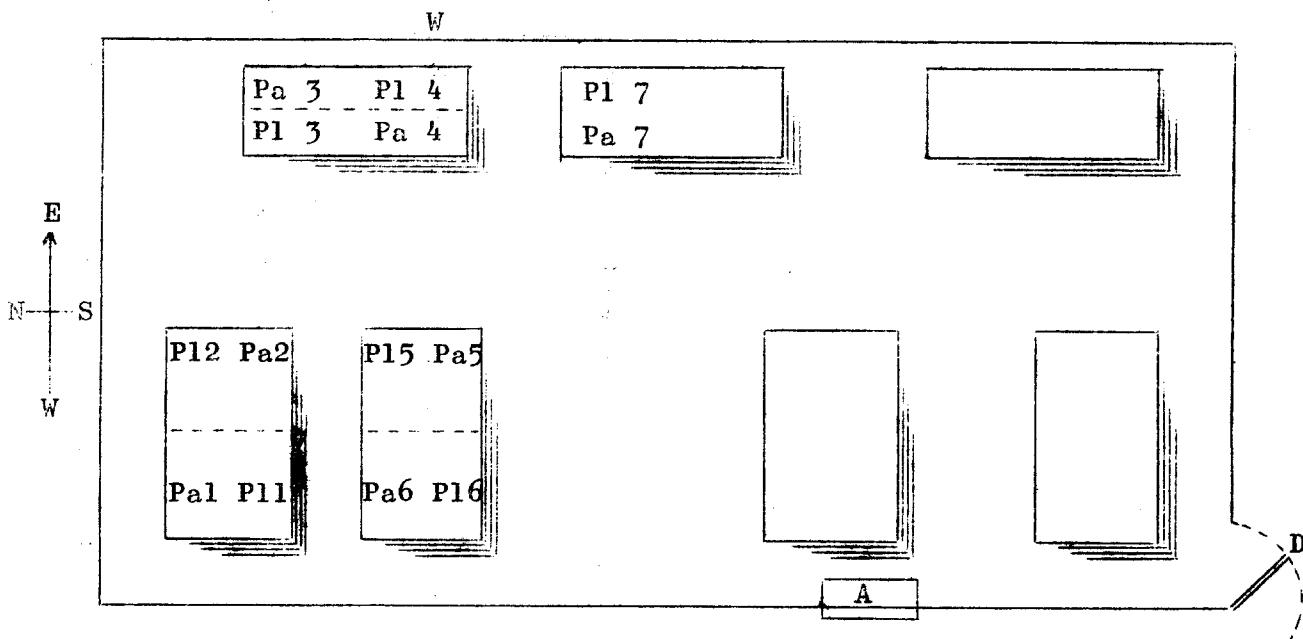
- Sewn laminated paper/plastic bags in 2-1-2 ratio of paper-plastic-paper.
- Sealed plastic bags.

Animal food in plastic bags were not tested because of the disadvantages of the plastic material.

Environmental conditions and diagram layout for exposure

1. In the depot, cleared site, samples were placed on the floor of the depot in seven different piles according to withdrawal number. The distribution of each replicate in the pile was so arranged that each one had chance to expose to the surrounding environments.
2. In the depot, jungle site, arrangements were made similar to that of the depot in the cleared site.
3. In air-conditioned (control) room.

Samples were placed on the lowest shelf, about 3 inches from the floor. Distribution of samples replicates were similar to those of the depots in cleared and jungle sites, but the diagram layout was different.



P1	= plastic bag	W	= clear window
Pa	= laminated paper/plastic bag	A	= air-conditioner
1,2,3,...7	= withdrawal number	D	= door

Withdrawal programme: 2,3,4,5,6,7 and 8 months after exposure (7 withdrawals). The scheduled programme is as follows:

Exposure date: 13 May 1972.

<u>Withdrawal number</u>	<u>Withdrawal dates</u>
1	12 July 1972
2	12 August 1972
3	12 September 1972
4	12 October 1972
5	12 November 1972
6	12 December 1972
7	12 January 1973

METHODS OF TESTS AND RESULTS

The concentrated animal food samples withdrawn from the exposure site were tested and analysed as follows:

Study of microorganisms, which comprised counting and test of different types of microorganism i.e. mold, aerobic bacteria, anaerobic bacteria, and coliform organisms.

Visual observation of food containers, and changes in physical appearance of food.

Study of weight changes.

Chemical analysis to confirm composition of food and to test for deterioration of mineral and nutritional value of food after storage for a certain period of time under different environmental conditions.

RESULTS

Results of tests and analysis are presented in the following tables:

- Table 1. Weight changes
- Table 2. Visual observation
- Table 3. Microbiological data
- Table 4. Chemical analysis

Weight changes

Before the exposure period and at the final (4th) withdrawal date, the materials were weighed to ascertain their weight changes, the results of which are shown in the following table.

TABLE 1. RESULTS OF WEIGHT CHANGES

Code number	Description	Original weight	Final weight	Weight
		(g) 28 May 72	(g) 17 Oct. 72	changes (g)
9-1-1-0-bD1	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 1	1114.8	1125.5	+ 10.3
9-1-1-0-bD2	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 2	1112.5	1127.5	+ 15.0
9-1-1-0-bD3	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 3	1101.8	1103.2	+ 1.4
9-1-1-0-bD4	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 4	1080.0	1090.6	+ 10.6
9-1-1-0-bDX	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # X	1120.9	1134.4	+ 13.5
9-1-1-I-bD1	Formula 1. Laminated paper/plastic bag, cleared site, fourth withdrawal, replicate # 1	1062.4	1071.3	+ 8.9
9-1-1-I-bD2	Formula 1. Laminated paper/plastic bag, cleared site, fourth withdrawal, replicate # 2	1111.5	1130.5	+ 19.0
9-1-1-I-bD3	Formula 1. Laminated paper/plastic bag, cleared site, fourth withdrawal, replicate # 3	1101.9	1119.5	+ 17.6
9-1-1-I-bD4	Formula 1. Laminated paper/plastic bag, cleared site, fourth withdrawal, replicate # 4	1097.3	1071.7	- 25.6
9-1-1-I-bDX	Formula 1. Laminated paper/plastic bag, cleared site, fourth withdrawal, replicate # X	1119.4	1134.0	+ 14.6
9-1-1-II-bD1	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 1	1124.9	1140.8	+ 15.9
9-1-1-II-bD2	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 2	1115.8	1127.4	+ 11.6
9-1-1-II-bD3	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 3	1114.9	1128.5	+ 13.6

TABLE 1. continued.

Code number	Description	Original weight	Final weight	Weight
		(g) 28 May 72	(g) 17 Oct. 72	changes (g)
9-1-1-II-bD4	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 4	1102.3	1122.0	+ 19.7
9-1-1-II-bDX	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # X	1108.8	1131.0	+ 22.2
9-5-1-0-bD1	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 1	1082.4	1079.3	- 3.1
9-5-1-0-bD2	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 2	1121.8	1122.3	+ 0.5
9-5-1-0-bD3	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 3	1150.9	1149.6	- 1.3
9-5-1-0-bD4	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 4	1081.6	1078.6	- 3.0
9-5-1-0-bDX	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # X	1119.6	1118.9	- 0.7
9-5-1-I-bD1	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 1	1072.5	1078.7	+ 6.2
9-5-1-I-bD2	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 2	1081.0	1079.8	- 1.2
9-5-1-I-bD3	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 3	1076.5	1075.2	- 1.3
9-5-1-I-bD4	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 4	1117.1	1114.9	- 2.2
9-5-1-I-bDX	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # X	1076.3	1078.0	+ 1.7
9-5-1-II-bD1	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 1	1126.5	1133.7	+ 7.2
9-5-1-II-bD2	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 2	1066.6	1076.8	+ 10.2
9-5-1-II-bD3	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 3	1102.9	1099.4	- 3.5

TABLE 1. continued.

Code number	Description	Original weight	Final weight	Weight
		(g) 28 May 72	(g) 17 Oct. 72	changes (g)
9-5-1-II-bD4	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 4	1153.8	1150.7	- 3.1
9-5-1-II-bDX	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # X	1076.5	1088.4	+ 11.9

Visual observation

Before and during the exposure period until the withdrawal date, visual observation of the food samples was made to see if deterioration had taken place in food containers and the foodstuff itself. The following table shows the results of observation.

TABLE 2. RESULTS OF VISUAL OBSERVATION

Code number	Description	Results of observation	
		Before exposure	After exposure 4th withdrawal
9-1-1-0-bD1	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 1	No defect	Container in good condition, pellets looked normal, insect infestation.
9-1-1-0-bD2	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 2	No defect	Container in good condition, pellets smashed, normal visible.
9-1-1-0-bD3	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 3	No defect	Container in good condition, pellets looked normal.
9-1-1-0-bD4	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 4	No defect	Container in good condition, pellets smashed.
9-1-1-0-bDX	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # X	No defect	Container in good condition, pellets looked normal, insect infestation.
9-1-1-I-bD2	Formula 2. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 2	No defect	Container in good condition, moldy, insect infestation, pellets smashed.
9-1-1-I-bD3	Formula 2. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 3	No defect	Container in good condition, pellets looked normal, insect infestation.
9-1-1-I-bD4	Formula 2. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 4	No defect	Container in good condition, moldy, pellets smashed, insect infestation.

TABLE 2. continued.

Code number	Description	Results of observation	
		Before exposure	After exposure 4th withdrawal
9-1-1-I-bDX	Formula 2. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # X	No defect	Container in good condition, pellets looked normal, insect infestation.
9-1-1-II-bD1	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 1	No defect	Container in good condition, mold visible from outside.
9-1-1-II-bD2	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 2	No defect	Container in good condition, pellets looked normal, moldy.
9-1-1-II-bD3	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 3	No defect	Container in good condition, pellets looked normal, moldy.
9-1-1-II-bD4	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 4	No defect	Container in good condition, moldy, insect infestation.
9-1-1-II-bDX	Formula 1. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # X	No defect	Container in good condition, pellets looked normal, moldy, insect infestation.
9-5-1-0-bD1	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 1	No defect	Container in good condition, smashed pellets, looked dry and normal.
9-5-1-0-bD2	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 2	No defect	Container in good condition, smashed pellets, looked dry and normal.
9-5-1-0-bD3	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 3	No defect	Container in good condition, smashed pellets, looked dry.
9-5-1-0-bD4	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # 4	No defect	Container in good condition, pellets looked normal and dry.
9-5-1-0-bDX	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # X	No defect	Container in normal condition, insect infestation.
9-5-1-I-bD1	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 1	No defect	Container in good condition, moldy, smashed pellets, insect infestation.
9-5-1-I-bD2	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 2	No defect	Container in good condition, smashed pellets, insect infestation.
9-5-1-I-bD3	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 3	No defect	Container in good condition, moldy, smashed pellets, insect infestation.
9-5-1-I-bD4	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # 4	No defect	Container in good condition, insect infestation, pellets looked less compact.

TABLE 2. continued.

Code number	Description	Results of observation	
		Before exposure	After exposure 4th withdrawal
9-5-1-I-bDX	Formula 5. Laminated paper/plastic bag, in depot, cleared site, fourth withdrawal, replicate # X	No defect	Container in good condition, smashed pellets, insect infestation, moldy.
9-5-1-II-bD1	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 1	No defect	Container in good condition, moldy, smashed pellets.
9-5-1-II-bD2	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 2	No defect	Container in good condition, moldy, smashed pellets.
9-5-1-II-bD3	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 3	No defect	Container in good condition, moldy, pellets smashed.
9-5-1-II-bD4	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # 4	No defect	Container in good condition, moldy, pellets smashed, insect infestation.
9-5-1-II-bDX	Formula 5. Laminated paper/plastic bag, in depot, jungle site, fourth withdrawal, replicate # X	No defect	Container in good condition, insect infestation, moldy.

Microbiological data

At the final (4th) withdrawal of the samples, microbiological study was undertaken by means of aerobic bacteria and mold counts, the results of which are shown in the following table.

TABLE 3. MICROBIOLOGICAL DATA

Code number	Description	Aerobic count (colonies/g)	Mold count (colonies/g)	Anaerobic test	Coliform test
9-1-1-0-bDX	Formula 1. Laminated paper/plastic bag, control room, fourth withdrawal replicate # X	2×10^4	8×10^2	-	-
9-1-1-I-bDX	Formula 1. in depot, cleared site, replicate # X	2×10^4	80×10^4	-	-
9-1-1-II-bDX	Formula 1. in depot, jungle site, replicate # X	60×10^4	250×10^4	-	-
9-5-1-0-bDX	Formula 5. Laminated paper/plastic bag, control room, fourth withdrawal, replicate # X	30×10^4	4×10^4	-	-

TABLE 3. continued.

Code number	Description	Aerobic count (colonies/g)	Mold count (colonies/g)	Anaerobic test	Coliform test
9-5-1-I-bDX	Formula 5. in depot, cleared site, replicate # X	18 x 10 ⁴	115 x 10 ⁴	-	-
9-5-1-II-bDX	Formula 5. in depot, jungle site, replicate # X	9 x 10 ⁴	660 x 10 ⁴	-	-

Chemical analysis

At the final (4th) withdrawal of the samples, analyses were made to ascertain the chemical properties, the result of which is shown in the following table.

TABLE 4. RESULTS OF CHEMICAL ANALYSIS

	Formula 1			Control room	Formula 5	
	Control room	Depot cleared site	Depot jungle site		Depot cleared site	Depot jungle site
% H ₂ O	9.98	12.91	13.47	9.91	12.20	13.45
% Ca	1.28	1.33	1.40	2.25	2.03	2.20
% P	0.62	0.57	0.71	0.96	1.01	1.00
% Free fatty acid	4.23	3.66	2.92	6.20	3.38	2.46
% Fat	4.75	0.83	0.72	5.27	1.47	0.93
% Ash	9.89	9.78	9.92	15.92	15.97	16.06
% Fibre	6.03	6.30	6.51	6.17	6.41	6.37
% Protein	15.27	15.20	15.30	9.81	10.06	9.87
% CHO	54.08	54.98	54.08	52.92	53.89	53.32
Net energy (kcal/kg)	3200	2900	2800	3000	2700	2600

Meteorological data

Graphical presentation of the observed meteorological parameters during the period 12 July - 12 October 1972 is given in figures, (for the period from the start of exposure until the 3rd withdrawal, the reader is referred to Report No. 1 on the same topic).

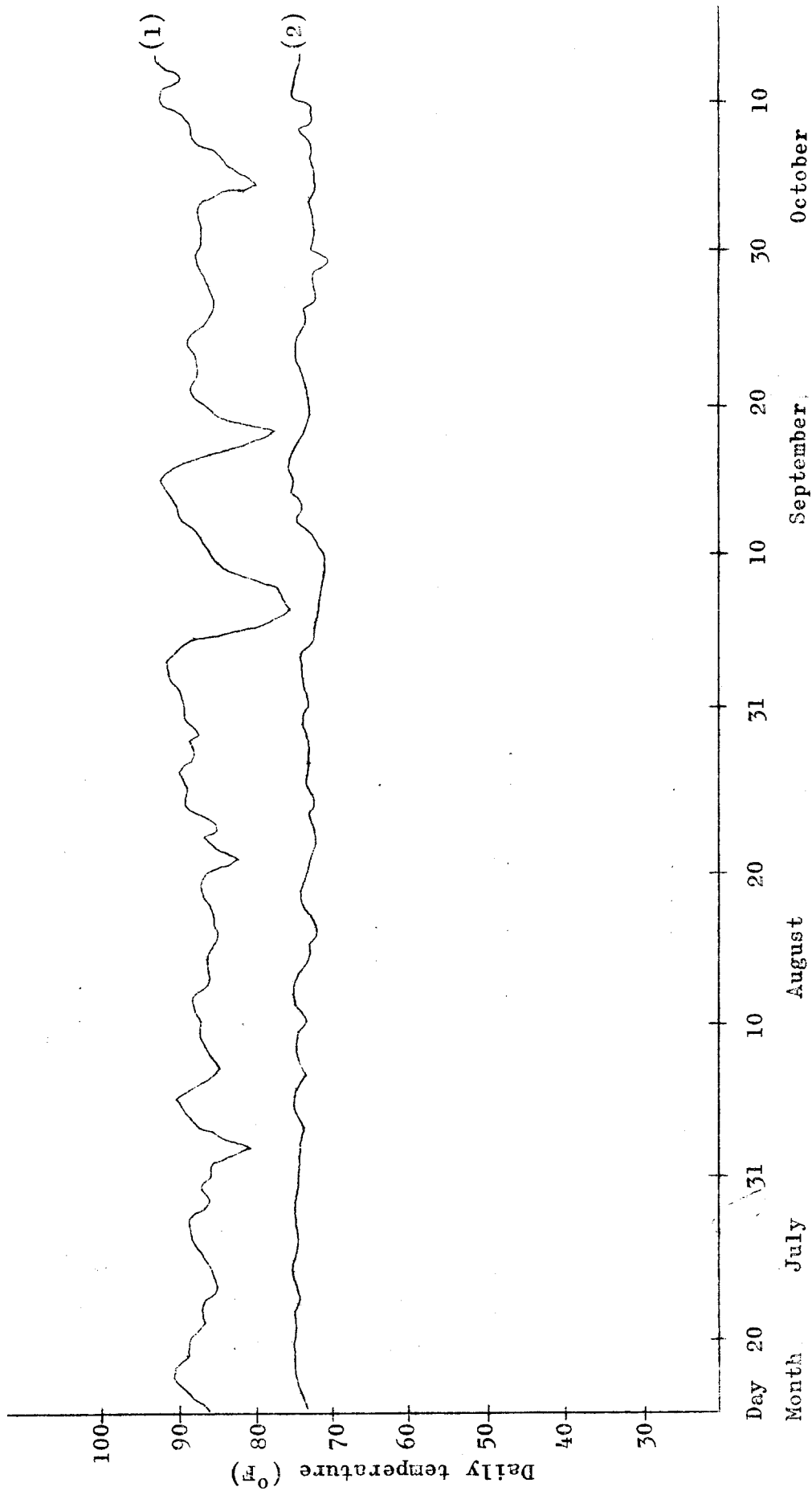


Figure 1. Graph showing temperature recorded at cleared site in the depot during the period 15 July - 12 October 1972.

(1) Daily maximum temperature.

(2) Daily minimum temperature.

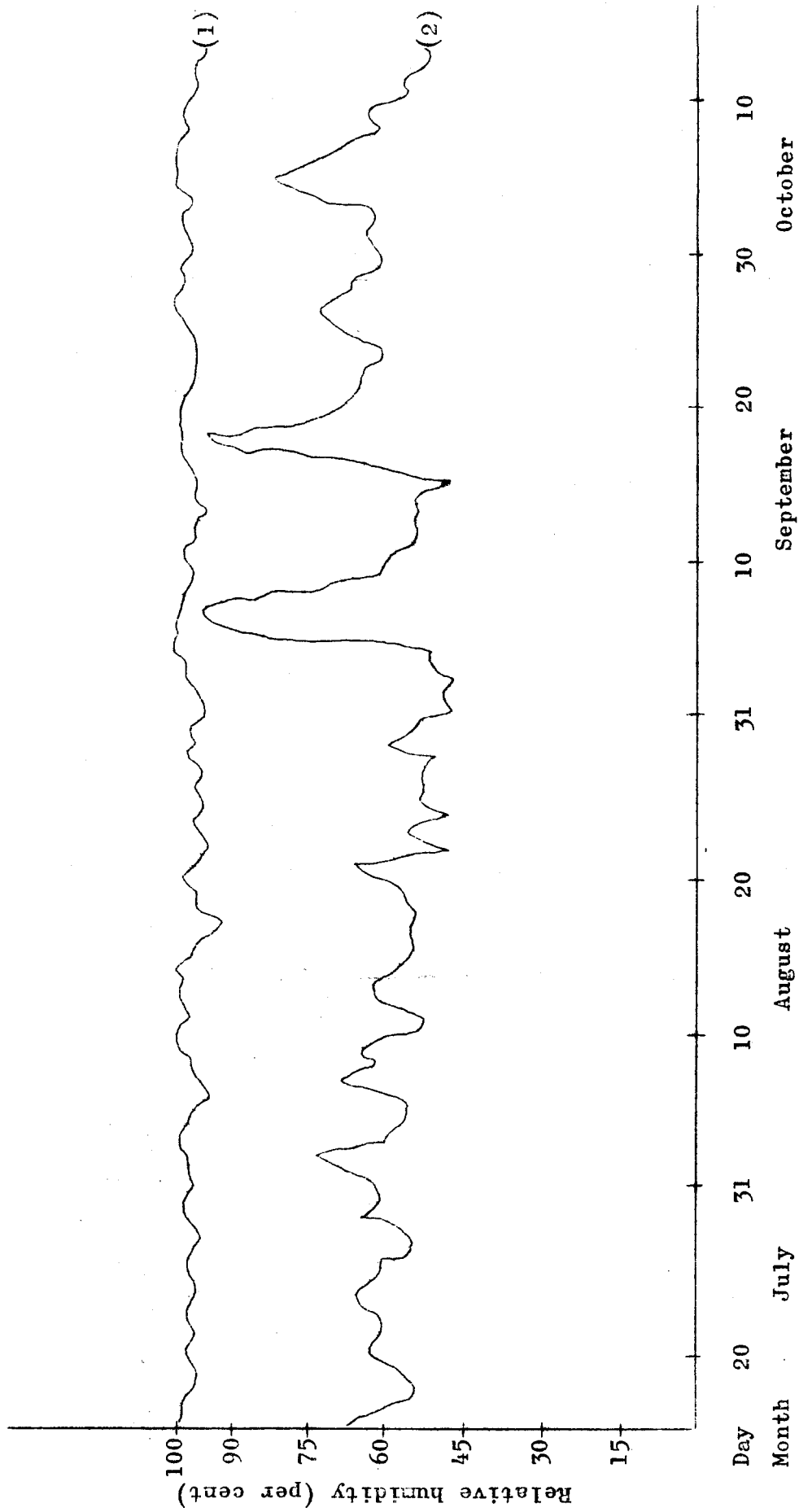


Figure 2. Graph showing relative humidity recorded at cleared site in the depot during the period 15 July - 12 October 1972.

(1) Daily maximum relative humidity.

(2) Daily minimum relative humidity.

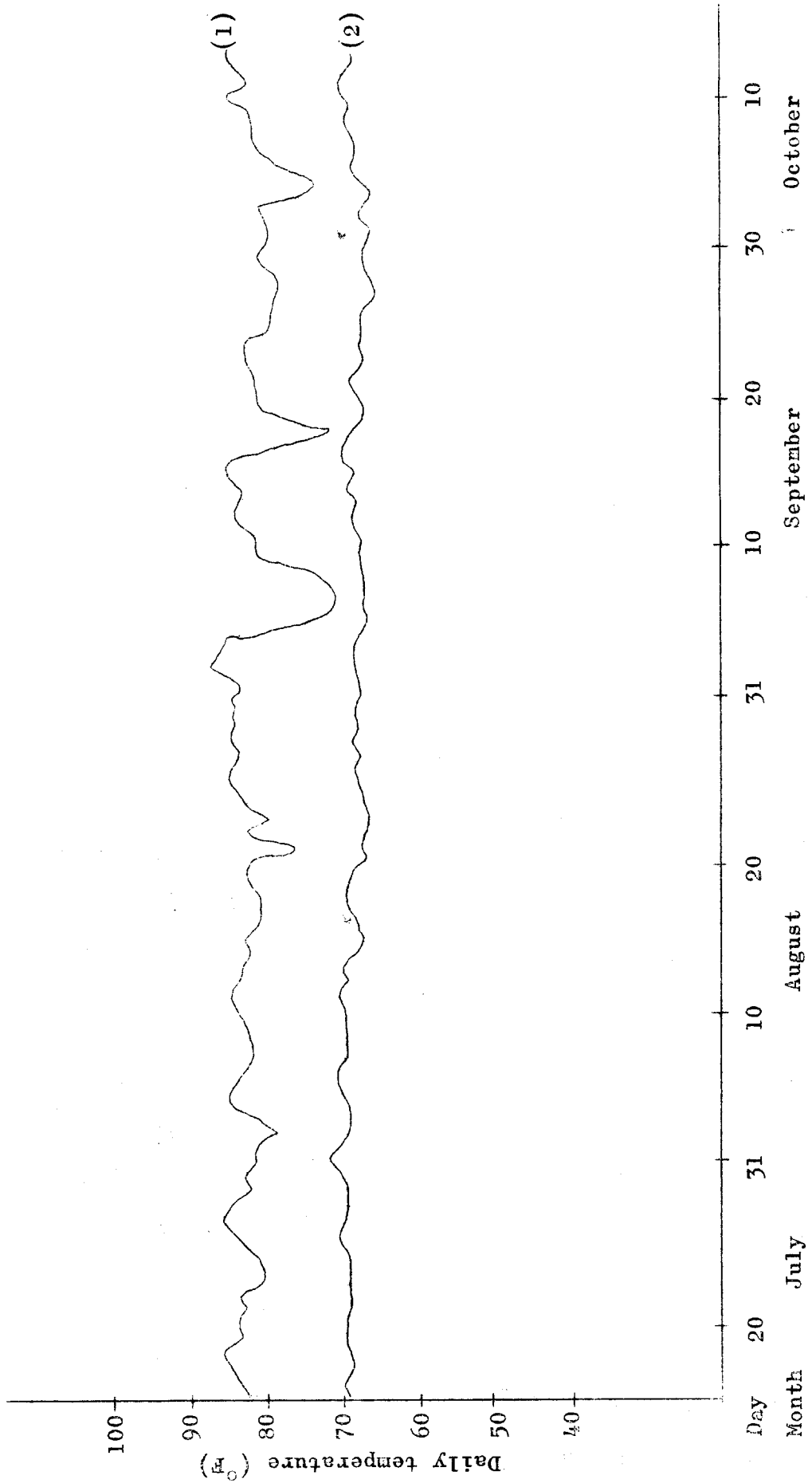


Figure 3. Graph showing temperature recorded at cleared site out of doors during the period 15 July - 12 October 1972.

- (1) Daily maximum temperature.
- (2) Daily minimum temperature.

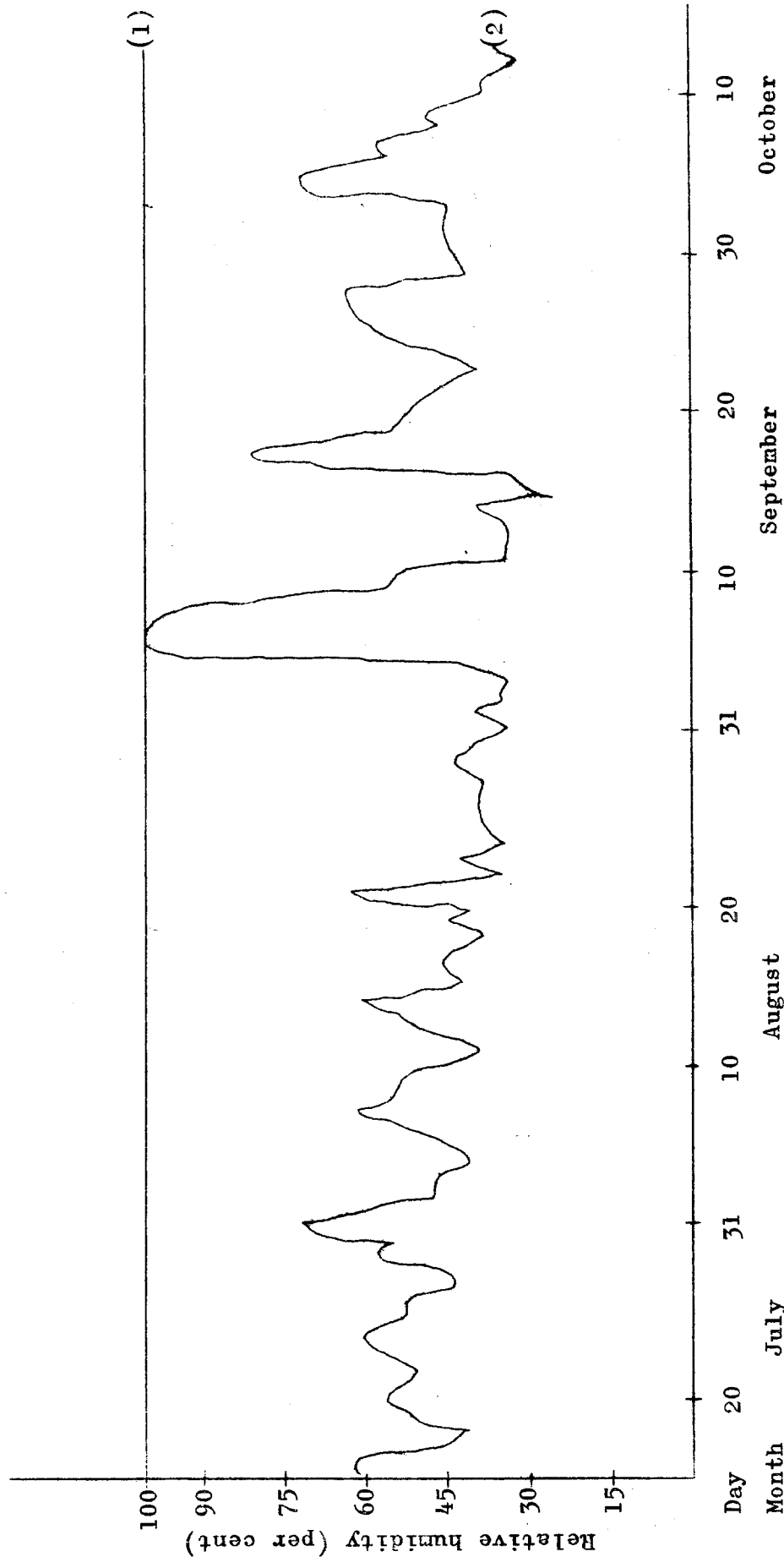


Figure 4. Graph showing relative humidity recorded at cleared site out of doors during the period 15 July - 12 October 1972.

- (1) Daily maximum relative humidity.
- (2) Daily minimum relative humidity.

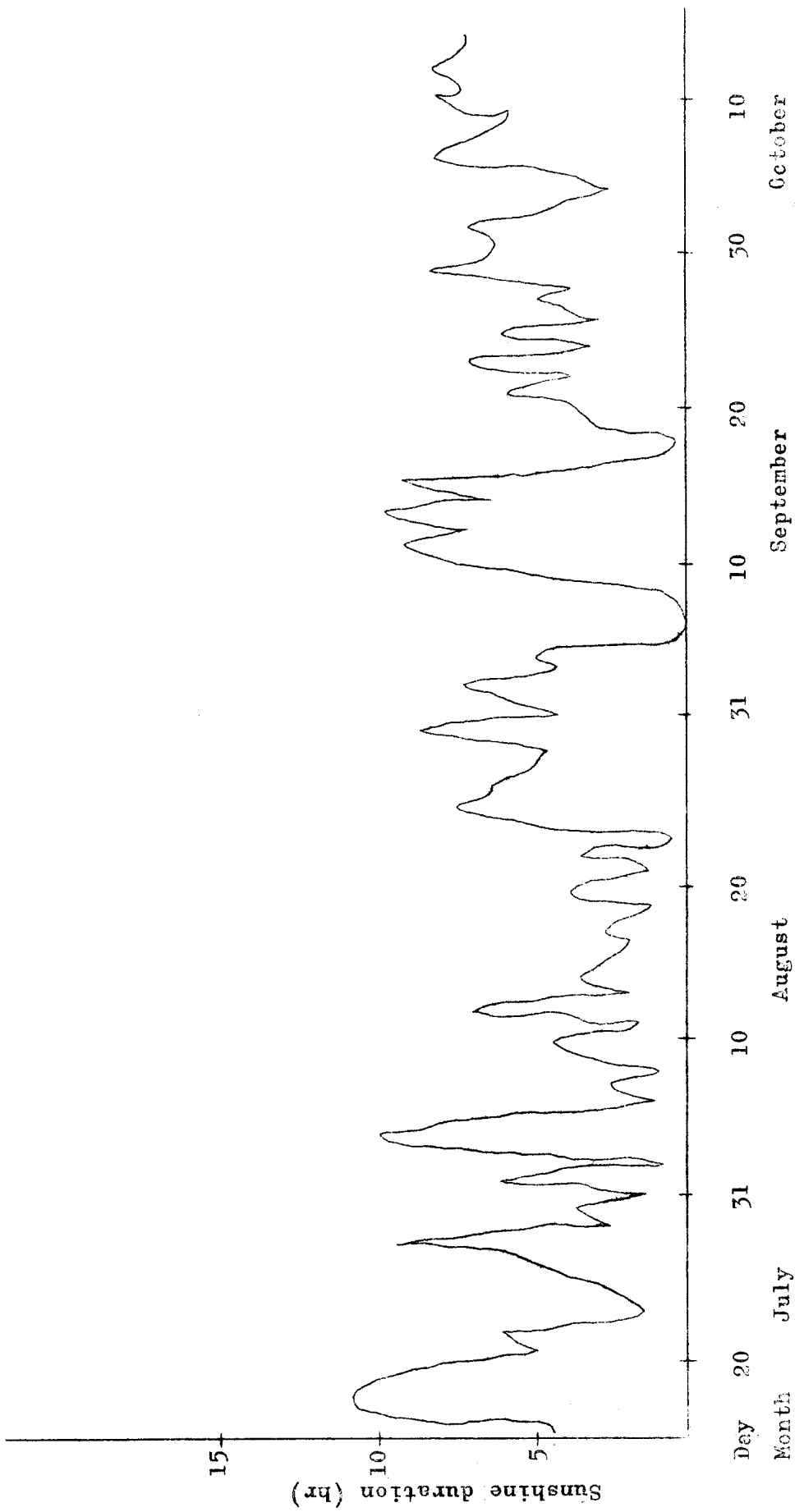


Figure 5. Graph showing sunshine duration recorded at the cleared site during the period 15 July - 12 October 1972.

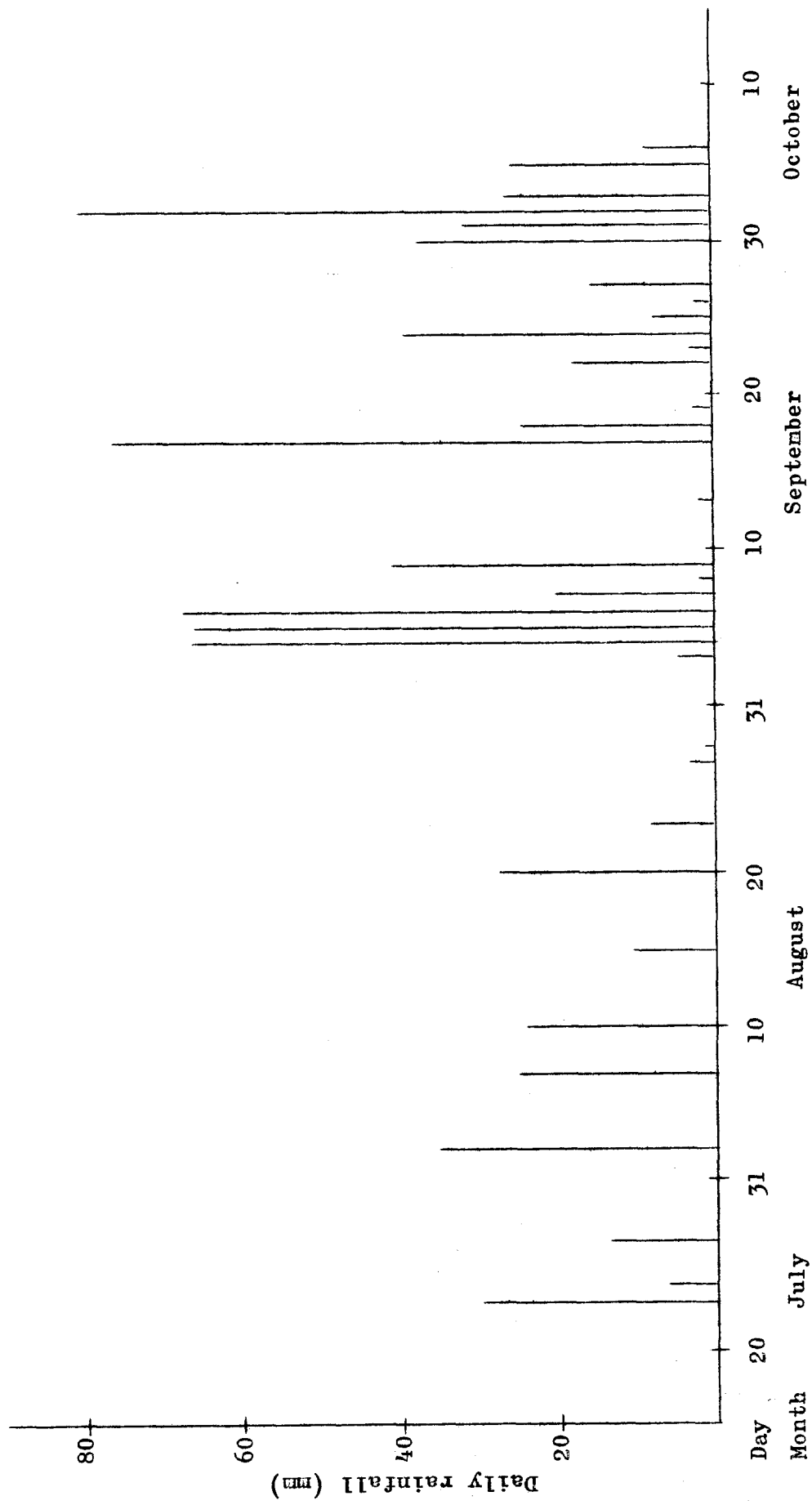


Figure 6. Graph showing daily rainfall recorded at the cleared site out of doors during the period 15 July - 12 October 1972.

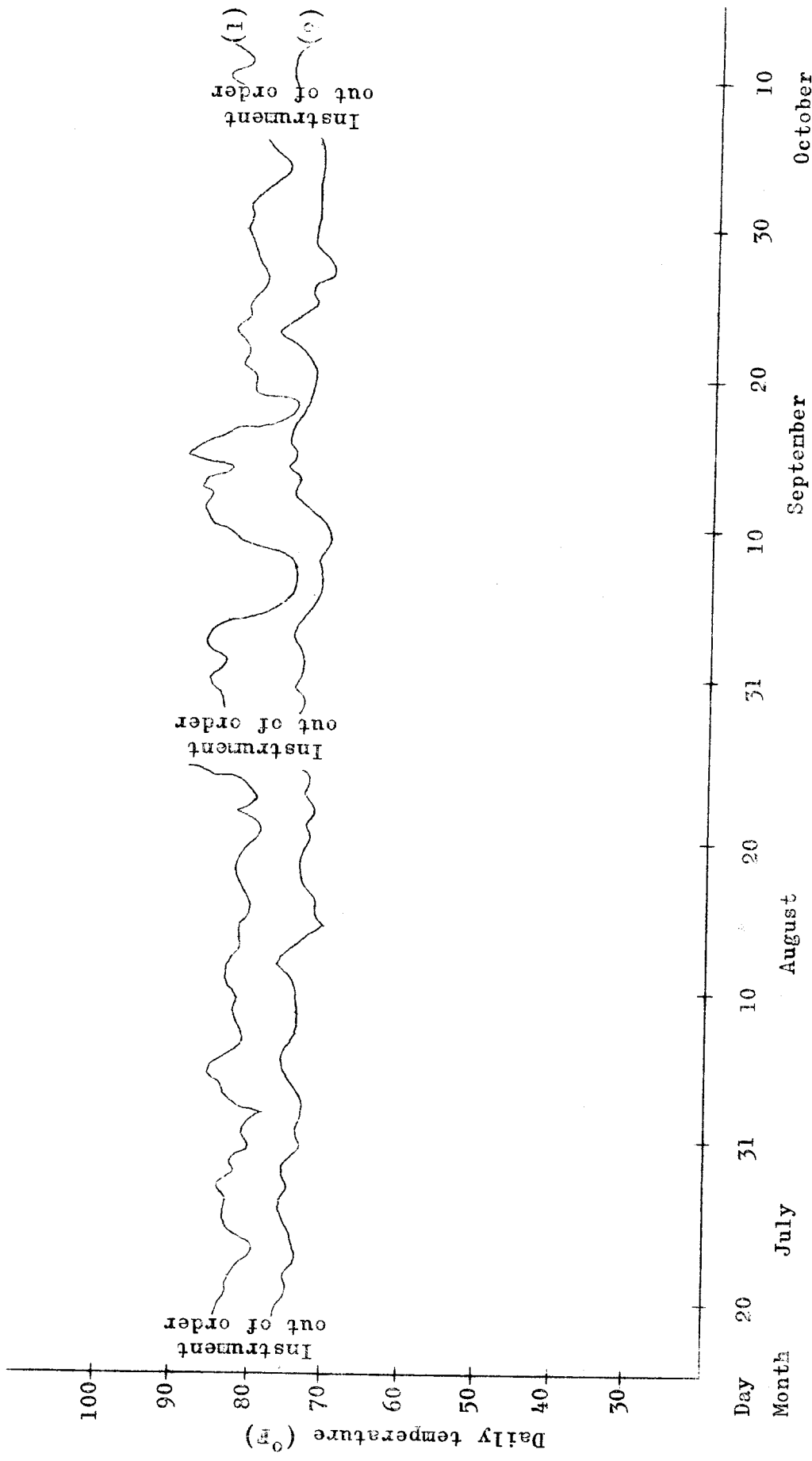


Figure 7. Graph showing temperature at the jungle site in the depot during the period 15 July - 12 October 1972.

- (1) Daily maximum temperature.
- (2) Daily minimum temperature.

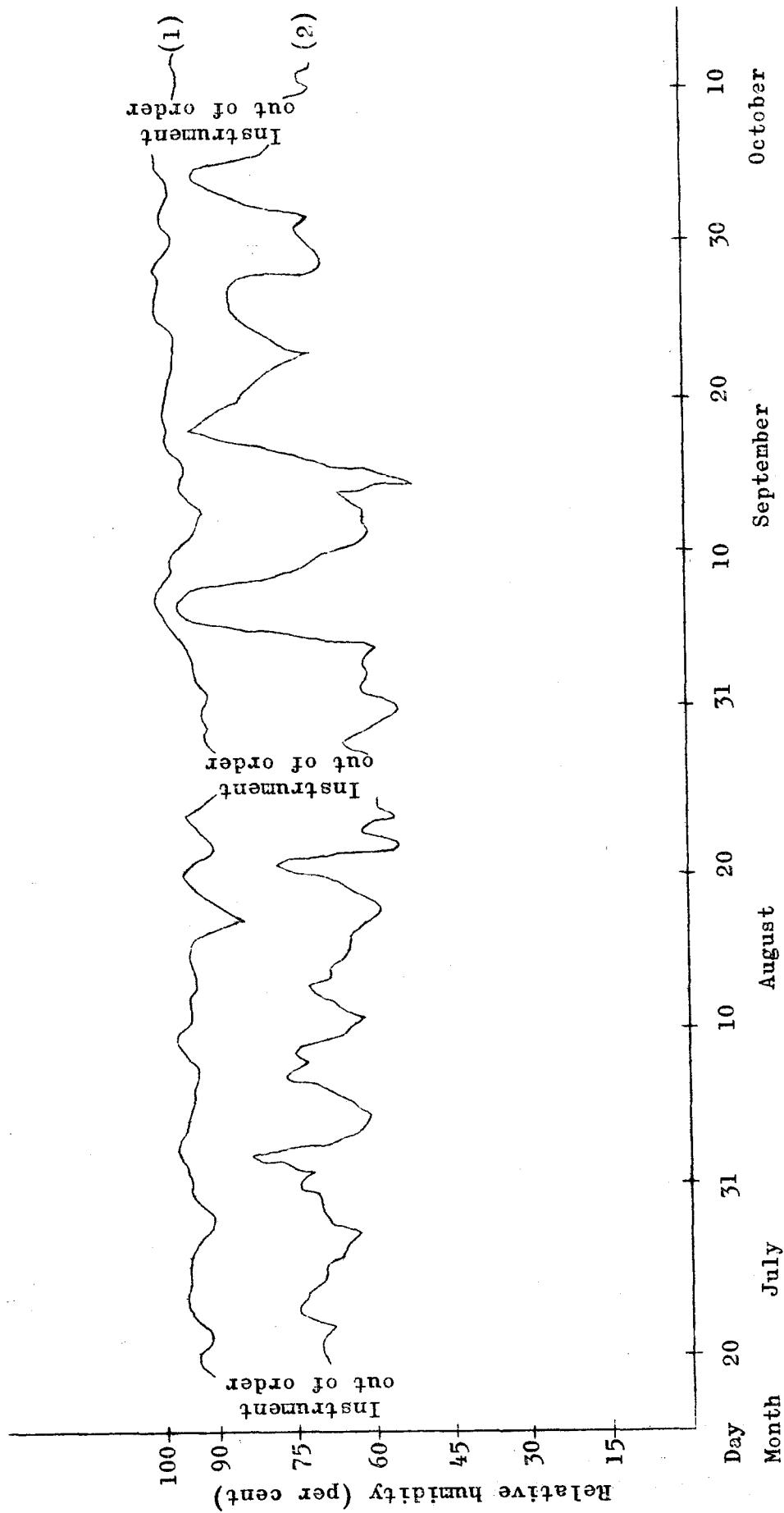


Figure 8. Graph showing relative humidity at the jungle site in the depot during the period 15 July - 12 October 1972.

- (1) Daily maximum relative humidity.
- (2) Daily minimum relative humidity.

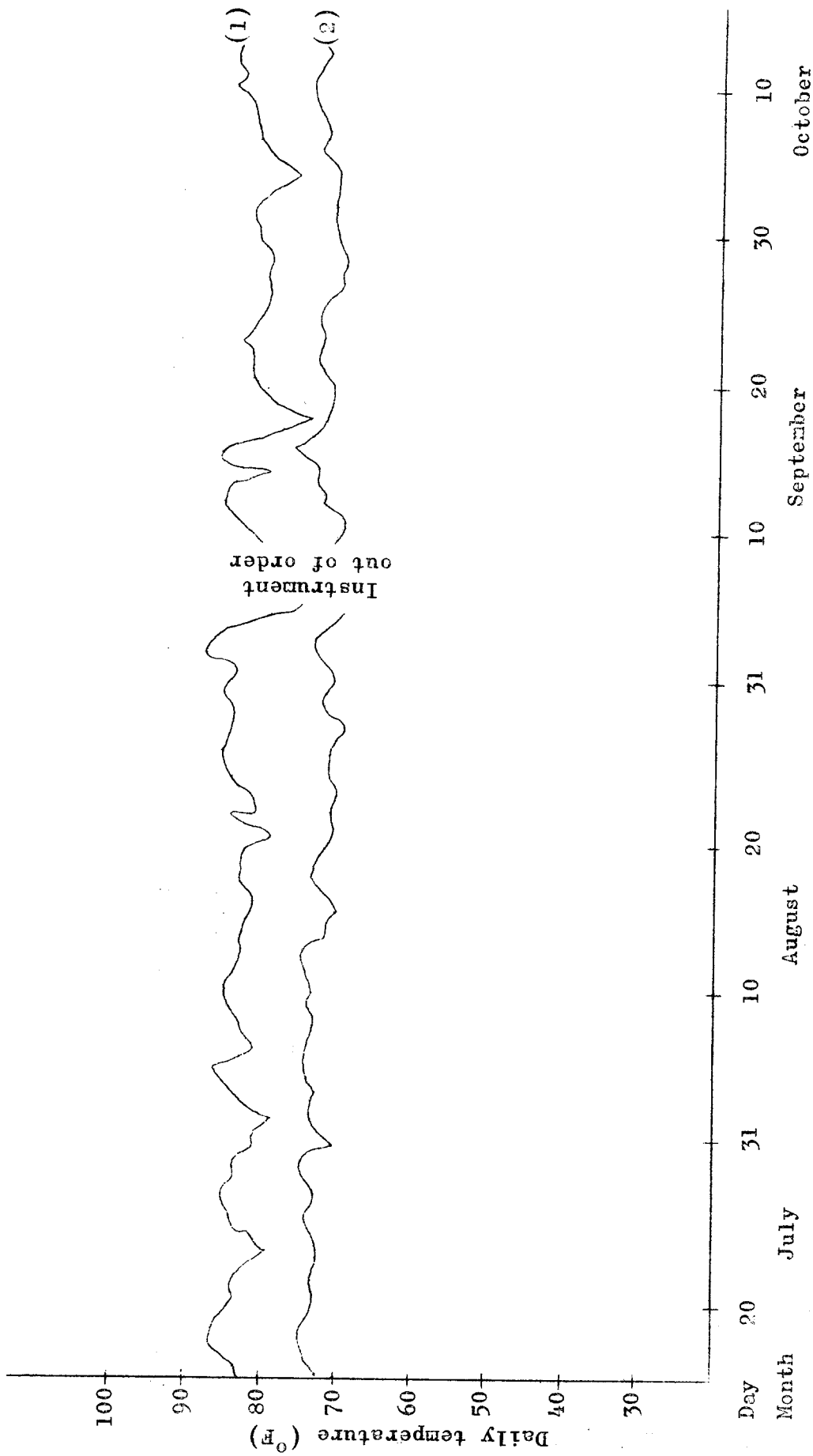


Figure 9. Graph showing temperature at the jungle site out of doors during the period 15 July - 12 October 1972.

- (1) Daily maximum temperature.
- (2) Daily minimum temperature.

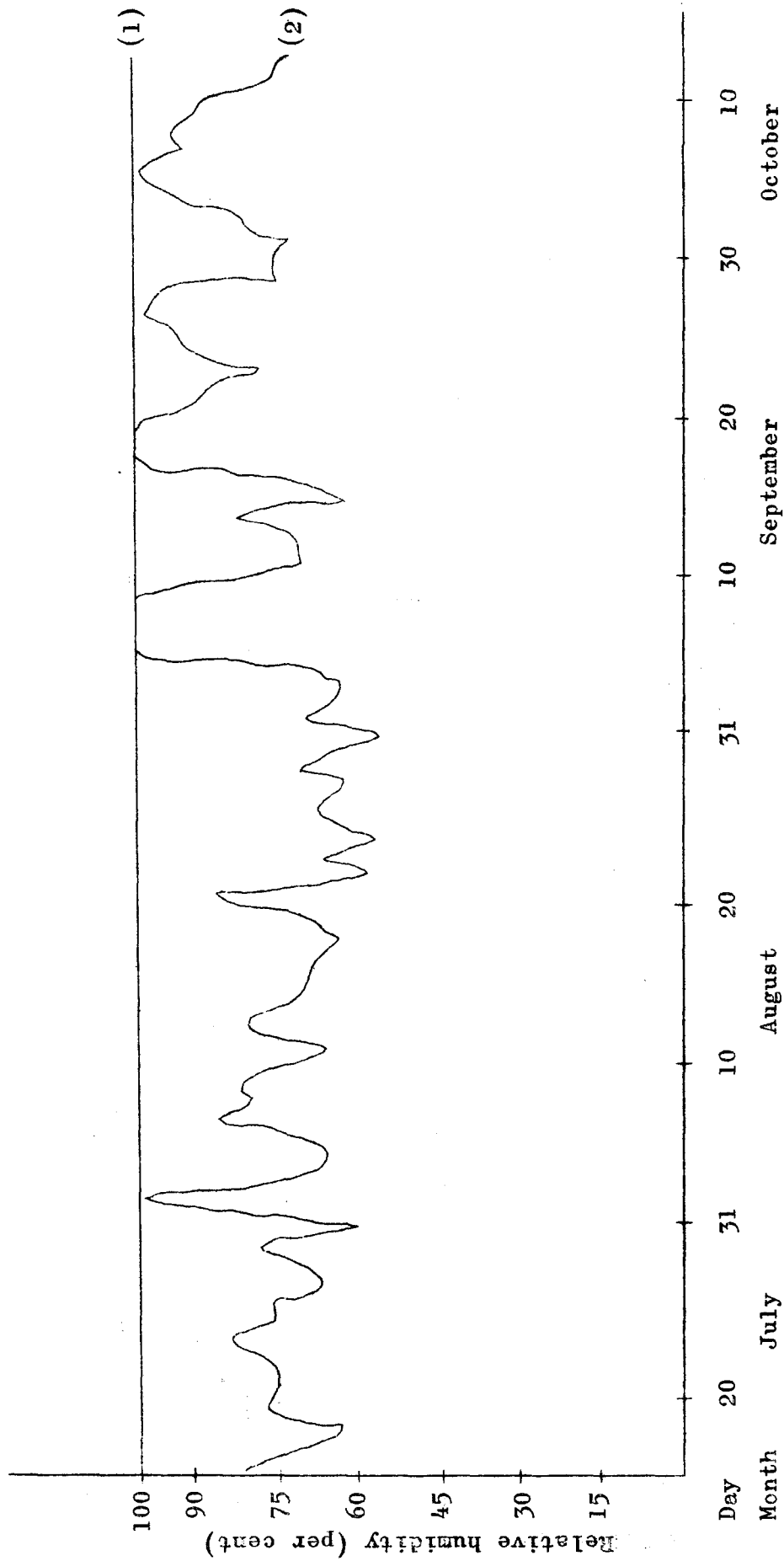


Figure 10. Graph showing relative humidity at the jungle site out of doors during the period 15 July - 12 October 1972.

- (1) Daily maximum relative humidity.
- (2) Daily minimum relative humidity.

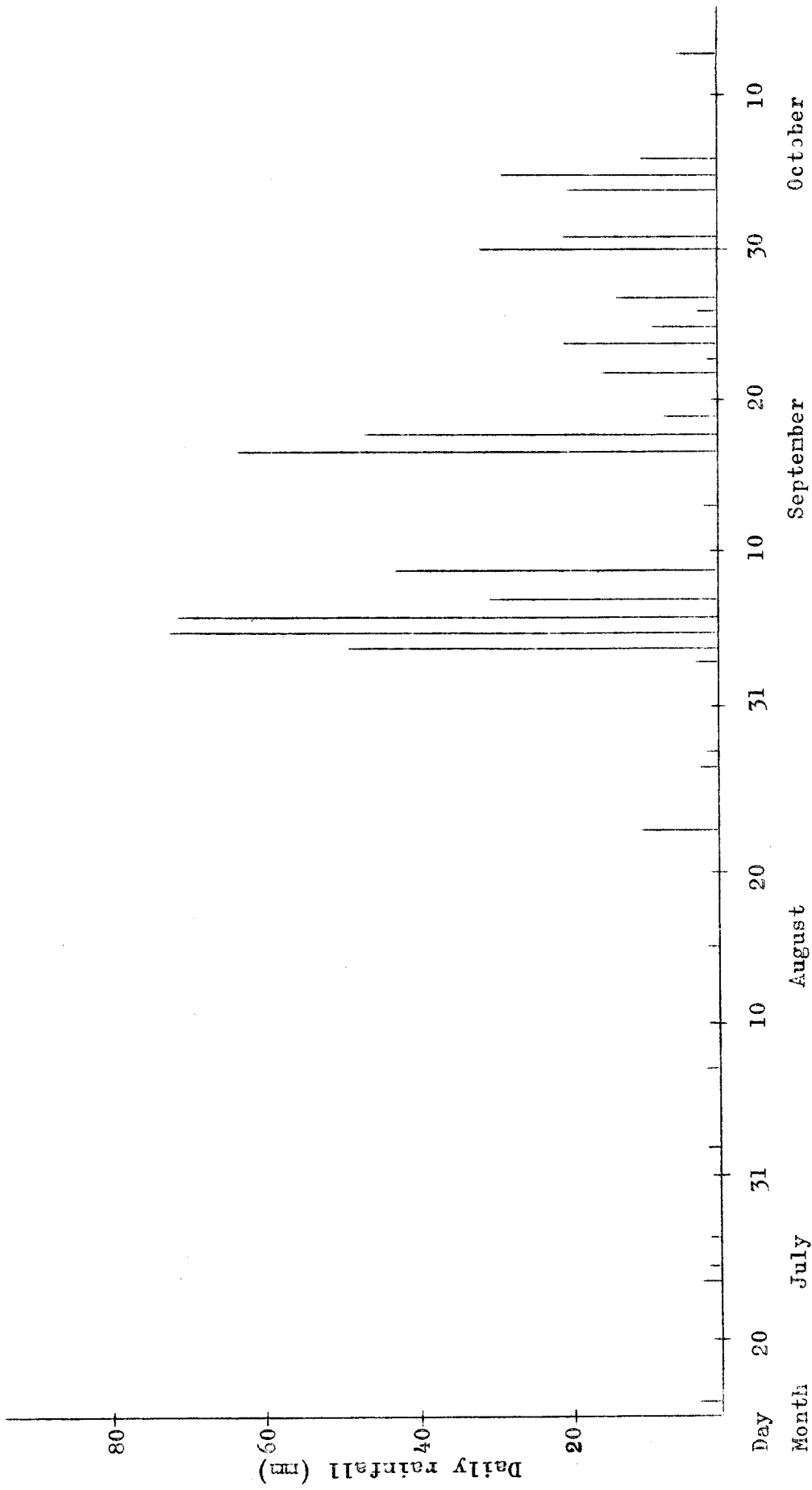


Figure 11. Graph showing rainfall recorded at the jungle site during the period 15 July - 12 October 1972.

DISCUSSION

Discussion on visual observation and weight changes

Visual observation made on animal food samples of the 4th withdrawal revealed that most, if not all of the food samples showed mold growth on the foodstuff. The degree of mold infestation varied, being greatest for those in the samples in the jungle site depot, and least for those in the air-conditioned room. In the air-conditioned room, a very slight trace of mold was visible in some packages. Insects found in the foodstuff were the usual type of beetle, and also some of a small louse-like type which was seen in some packages. The results revealed that the foodstuff has progressively deteriorated with respect to mold and insect infestation. Containers of laminated paper/plastic type were found to be satisfactory up to the 4th withdrawal, although they could not withstand attack by mice which was reported from time to time.

Changes in weight since the samples were initially weighed are mostly uniformed with those of the previous withdrawal, except in cases of spillage or removal by vermin, which was an obvious factor observable at the time of withdrawal. Another possible factor contributing to the weight changes is believed to be fluctuation of humidity occurring in the vicinity where food samples were exposed. This humidity is believed to be an important factor contributing to mold growth in the foodstuff.

Discussion of microbiological test results

The populations of varieties of microorganisms, for which tests were made, on the selected samples, appeared to have a relatively higher order than at the previous withdrawal. Neither anaerobic nor coliform bacteria appeared in any of the samples tested. The mold counts of 10^3 to 10^6 colonies per gramme probably present "saturation" measurement. This means that the conspicuous mold in one gramme of sample does, on dispersion in water and dilution, fall into between 10^3 and 10^6 viable fragments.

Discussion of results of chemical analysis

Quantities of calcium, phosphorus and "ash" reported have maintained their level nearly the same as at the previous withdrawal at all the exposure sites. The same applied in the cases of "protein" and "fibre".

The content of free fatty acid remained nearly unchanged for samples in the control room, but was slightly higher for both formulae. For samples stored in the depots in both cleared, and jungle sites the free fatty acid content dropped considerably. This might have been because the free fatty acid was destroyed in the depots, and produced in the control room.

Fat remained rarely unchanged in samples in the control room, and has dropped considerably in samples stored in the depots. The loss is presumably due to biological consumption. The level of carbohydrate did not change appreciably. The same applied to estimated net energy.

Discussion of meteorological observation

The concentrated animal food samples of the 4th withdrawal were subjected to exposure to the environmental condition from about mid May to about mid October 1972. The period from the middle of August until the beginning of October (between the 2 previous withdrawals and the one with which this report is concerned) falls within the wet season at Sakaerat. Rainfall high, both in quantity and frequency, was reported to have occurred at the beginning and during the latter part of September continuing into the beginning of October. The concurrent high humidity of this wet period was believed to have contributed to the deterioration of the animal food samples. Temperature trend followed the same pattern almost throughout the exposure period. Some dip in the daily maximum appeared in early and latter part of September as well as at the beginning of October when there was heavy rainfall, and cloud covered the area (no sunshine). This condition is also believed to make food samples deteriorate more rapidly than clear, dry conditions.

CONCLUSION

Conclusion is drawn mainly on visual observations made by microbiologists at ASRCT, together with results of microbiological tests and chemical analysis.

Concentrated animal food samples stored until the fourth withdrawal (13 May - 12 October 1972) have arrived at the end of their shelf life in the cases of those stored in the depots, in the cleared and jungle sites. Therefore it is recommended that the food samples stored under the above conditions should not be fed to animals. However, the food samples stored in the air-conditioned room may still be safe, but we would not confirm their safety without conducting animal feeding trials.

Chemical analysis indicated that the nutritional value (in terms of carbohydrate, protein, fat, and net energy) was probably still nearly as high as when the food was received. It was not known how much the vitamin contents may have been reduced or augmented by organisms present.

Whether the food was or was not safe for consumption, the writers feel there is a possibility that animals (mules, horses, etc.) would have refused all of the test samples even of the previous withdrawal. Feeding trials would have been useful in this respect should they have been applied in this programme.

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APPENDIX

TEST PLAN

SAKAERAT EXPERIMENT STATION

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

Subject: Concentrated animal food

1. Sponsor: Military Research and Development Center (MRDC)

Supreme Command Headquarters

Liaison personnel: Thai: Col. Adulsuck Mitrabhuckdi,
Maj. Howard S. De Witt

Manufacturer: Charoen Phokphan Feed Mill Co. Ltd.,
Chan Road, Yan Nawa, Metropolitan

2. Purpose: To determine shelf life of the animal food samples which are exposed under shelters of different environmental conditions, and are to be assessed from the rate of deterioration, the growth of mold, changes in nutritional value, and defect of packages.

3. Scope of trial:

Number of type	:	2
Number of withdrawal	:	7
Number of sites	:	3
Number of replicates	:	5

4. Exposure:

<u>Cleared site:</u>	indoors, on wooden floor and on shelf
<u>Jungle site:</u>	indoors, on wooden floor and on shelf
<u>Control room:</u>	indoors, on shelf

5. Assessment:

Visual on site
Microbiological growth
Chemical analysis of nutritional value
Changes in weight

6. Withdrawal programme: 2-3-4-5-6-7 and 8 months (7 times)

7. Meteorological data: Routine

8. Report:

1 at each withdrawal
2 final