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The Use of the Milking Machine by the Hydropulse System

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新型式「ハイドロパルスミルカー」による機械搾乳について

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瀧ヶ平武昭**

Introduction

The requirement of machine milking in dairy enterprises is increasing year after year all over the world. This should result in labor saving and ejection of quality milk from healthy cows. The new Hydropulse system is said to be one of the most favorable milking machines and was developed through comprehensive research work based on the physiological and mechanical studies carried out by Alfa Laval AB, Tumba. Sweden. From 1966, this machine has been widely sold in European countries and highly recommended by dairy farmers. At the present time many kinds of milkers are on the market in Japan and there are many problems to be solved. Some of the problems which often occur are susceptibility to mastitis, deformity of teats and discomfort to dairy cows. To determine the proper use of the Hydropulse system in the case of pail type and parlour type milking machine a series of experiments have been conducted from the fall of 1966. This paper reports a comparison between Alfa Laval pail type milking machines P 77 and HP 87 and how they affect the milk yield and machine on time. The test was carried out during the winter season when the temperature is low, sometimes reaching below −15°C. The authors acknowledge the technical advices given by Mr. BERGLIND, Mr. K. SWENSON, Mr. A. MATTSON, Mr. I. MATTSON, Mr. HAEGGBLOM, Alfa Laval AB and Prof. Claesson, Uppsala Univ. who gave scientific suggestions during the planning of this research work.

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Experimental Procedure

This project was discussed with Mr. SWENSON and Mr. HAEGGBLOM on the 25th of July, 1966 and was carried out as a full research program after Prof. OOHARA's return to Japan.

1. Milker for testing

These milkers have been introduced by Alfa Laval, Sweden. P 77 is the original type widely used by dairy farmers for the past 8 years. HP 87 is the new milking machine recently developed by Alfa Laval and has been distributed in some European countries since 1966.

2. Duration of experiment

This test was carried out from the 2nd of December, 1966 to the 22nd of March, 1967.

3. Period of experiment

Stage	Milker for testing	Vacuum	Length of period
1	Original (P 77)	33 cm Hg	4 weeks
2	Hydropulse (HP 87)	38 cm Hg	4 weeks
3	Original (P 77)	33 cm Hg	4 weeks

4. Numbers of milking cows for testing

a) Two cows (No. 228 and No. 265) were the lactation of 7 weeks after calving fed at the stanchion barn and b) 27–33 milking cows fed at the 4 double Herringbone system parlour.

5. Items to be surveyed

The numbers of cows (parlour type), milk yield, fat %, milking time (machine on time) and time for stripping, mastitis problem, No. of leucocytes per c.c. and amounts of feed consumed by cows (parlour type) and the meteological data.

Milk yield from each parlour type cow was weighed by the Milk-O-Meter and concentrates consumed by the cows were measured by the Feed-O-Meter. Sometimes milk samples were taken from the cows for testing.

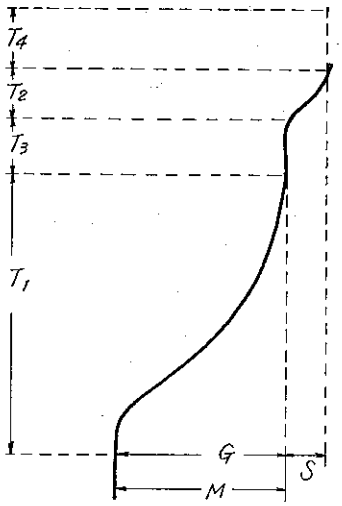
Feeding by the stanchion system during the testing period. Feed per day: hay 8 kg, corn silage 25 kg, concentrate 3 kg (DCP 20.5%, feed unit 1).

Record from the Milk-O-Graph are calculated as follows.

T: Machine on time

T_1: Time for milking

T_2: Time for machine stripping
T_3: Time for first over milking
T_4: Time for second over stripping
G : Total milk yield machine
M : Milk yield for machine milking
S : Milk yield for machine stripping



Results and discussion

a) Test made with pail type milker

1. Milk yield

The yield of milk and machine on time was tested to determine the comparison between P 77 and HP 87 and are shown as follows.

Comparison of the milk yield and milking time between P 77 and HP 87 are shown as follows.

As shown in the Table 1, the milk yield from an HP 87 increased 14% in comparison to that of a P 77. Particularly, the milk yield for machine milking with an HP 87 increased 23% more than that of the P 77 and in contradiction to this result the milk yield for machine stripping decreased with the use of the HP 87 as compared with the P 77. This tendency means that the HP 87 milker

Table 1. Milk yield and machine on time with P 77 and HP 87

Type of milker: P 77

Date of milking		Milk yield (kg)		Milk on machine (kg)	Machine stripping (kg)	T_1[1)]	T_2	T	T_3	T_4
Jan. 15	M	7.10	11.7	11.4	0.3	5′ (300)	1′ (60)	360″	30″	60″
	A	3.15	6.0	4.8	1.2	4 (240)	1 (60)	300	25	20
16	M	7.00	12.0	8.4	3.6	4 (240)	2 (120)	360	0	15
	A	2.52	7.5	7.2	0.3	3′40″(220)	1′50″(110)	330	30	90
17	M	6.45	13.4	12.0	1.4	6 (360)	1 50 (110)	470	120	20
	A	3.20	7.8	6.6	1.2	3 40 (220)	1 10 (70)	290	50	80
18	M	6.55	12.8	10.2	2.6	6 40 (400)	1 30 (90)	490	30	0
	A	3.15	6.9	6.0	0.9	3 (180)	2 (120)	300	40	20
19	M	6.40	11.8	10.8	1.0	7 (420)	3 (180)	600	80	40
	A	3.00	6.3	6.0	0.3	3 20 (200)	1 (60)	260	40	50
20	M	6.57	12.0	11.0	1.0	6 10 (370)	1 20 (80)	450	80	40
	A	2.50	6.7	6.0	0.7	2 50 (170)	2 (120)	290	20	90
21	M	7.10	10.2	8.4	1.8	4 20 (260)	50 (50)	310	30	135
	A	3.50	3.4	2.4	1.0	2 50 (170)	2 (120)	290	80	40
Average	M		11.9	10.3	1.6	336	99	435		
	A		6.3	5.5	0.8	200	94	294		
Total per day			18.2	15.8	2.4	536	193	729		

Remarks: For the meaning of T_1, T_2, T, T_3, T_4 see page 37 and 38 of this paper.

Second feeding stage

Type of milker: HP 87

Date of milking		Milk yield (kg)		Milk on machine (kg)	Machine stripping (kg)	T_1	T_2	T	T_3	T_4
Jan. 29	M	8.34	13.6	12.6	1.0	5′ (300)	2′35″(155)	455	30	15
	A	5.07	7.3	7.2	0.1	3′35″(215)	40 (40)	255	30	60
30	M	8.40	13.2	12.2	1.0	6 15 (375)	30 (30)	405	60	95
	A	4.24	8.0	7.2	0.8	4 (240)	1 50 (110)	350	60	40
31	M	8.38	13.4	12.2	1.2	4 30 (270)	1 30 (90)	360	0	80
	A	5.10	7.5	7.2	0.3	3 15 (195)	1 50 (110)	305	20	60
Feb. 1	M	8.32	13.4	13.2	0.2	5 20 (320)	1 40 (100)	420	0	60
	A	5.13	7.2	6.6	0.6	4 (240)	40 (40)	280	40	70
2	M	8.47	13.6	12.0	1.6	4 35 (275)	40 (40)	315	25	60
	A	5.05	7.0	6.8	0.2	4 10 (250)	30 (30)	280	20	30
3	M	8.35	13.5	12.6	0.9	4 30 (270)	1 10 (70)	340	30	0
	A	5.30	7.8	7.4	0.4	4 (240)	1 (60)	300	75	30
4	M	8.33	13.8	13.2	0.6	5 15 (305)	30 (30)	335	0	35
	A	5.23	7.3	7.2	0.1	4 20 (260)	40 (40)	300	0	40
Average	M		13.5	12.6	0.9	302	73	375		
	A		7.4	6.9	0.5	234	61	295		
Total per day			20.9	19.5	1.4	536	134	670		

Third feeding stage

Type of milker: P 77

Date of milking		Milk yield (kg)		Milk on machine (kg)	Machine stripping (kg)	T_1	T_2	T	T_3	T_4
March 1	M	8.28	10.6	10.6	0.1	6′40″(400)	5″(5)	405	0	65
	A	5.30	7.1	7.0	0.1	3 50 (230)	15 (15)	245	0	90
2	M	8.52	11.6	9.6	2.0	5 50 (350)	1′30″(90)	440	70	60
	A	5.17	6.2	4.8	1.4	2 30 (150)	1 30 (90)	240	0	60
3	M	8.32	12.0	10.8	1.2	5 50 (350)	30 (30)	380	65	20
	A	5.11	7.0	6.0	1.0	3 15 (195)	1 50 (110)	305	0	0
4	M	8.45	12.0	10.8	1.2	6 15 (375)	45 (45)	420	45	60
	A	5.16	7.0	6.0	1.0	3 50 (230)	3 (180)	410	0	15
5	M	8.32	10.7	9.6	1.1	5 30 (330)	2 15 (135)	465	0	30
	A	5.10	7.3	4.8	2.5	6 15 (375)	2 (120)	495	0	0
6	M	8.37	11.6	10.8	0.8	7 (420)	5 (5)	425	35	45
	A	5.15	6.7	6.0	0.7	4 (240)	1 (60)	300	0	45
7	M	8.28	11.0	8.4	2.6	4 30 (270)	1 15 (75)	345	0	50
	A	4.47	6.7	4.8	1.9	2 50 (170)	1 (60)	230	0	50
Average	M		11.4	10.1	1.3	356	55	411		
	A		6.8	5.6	1.2	227	91	318		
Total per day			18.2	15.7	2.5	583	146	729		

Table 2. Comparison of milk yield between P 77 and HP 87

Type of milker	Stage	Milk yield (kg)	Milk on machine (kg)	Machine stripping (kg)
P 77	Average of 1st and 3rd stage	18.2 (100)	15.75 (100)	2.45 (100)
HP 87	2nd stage	20.9 (114)	19.5 (123)	1.4 (57)

Table 3. Comparison of time for milking between P 77 and HP 87

Type of milker	Daytime	Stage	T_1	T_2	T
P 77	Morning	Average of 1st and 3rd stage	346″ (100)	77″ (100)	423″ (100)
HP 87		2nd stage	302 (87)	73 (94)	375 (88)
		Difference	−44	−4	−48
P 77	Afternoon	Average of 1st and 3rd stage	213.5 (100)	92.5 (100)	306 (100)
HP 87		2nd stage	234 (109)	61 (66)	295 (96)
		Difference	20.5	−31.5	−11
P 77	Total		559.5 (100)	169.5 (100)	729 (100)
HP 87			536 (96)	134 (79)	670 (92)
		Difference	−23.5	−35.5	−59

is very effective in accerelating machine milking and in decreasing machine stripping. By using the HP 87, milking time can be saved.

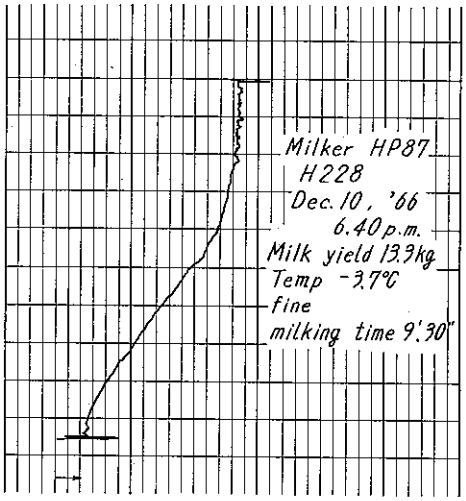
2. Milk flow

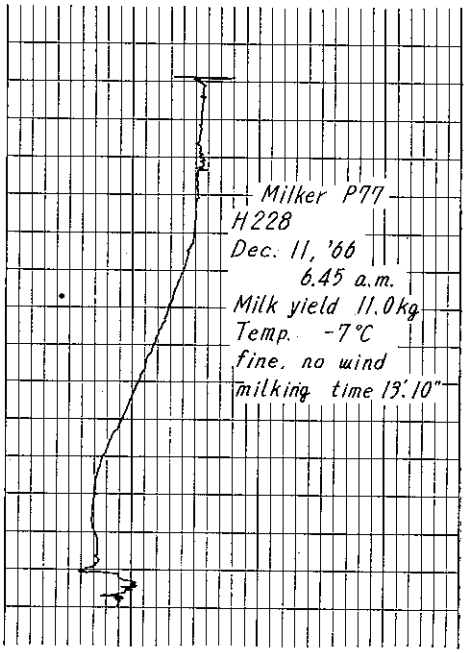
The rate of milk flow per minute is shown as follows.

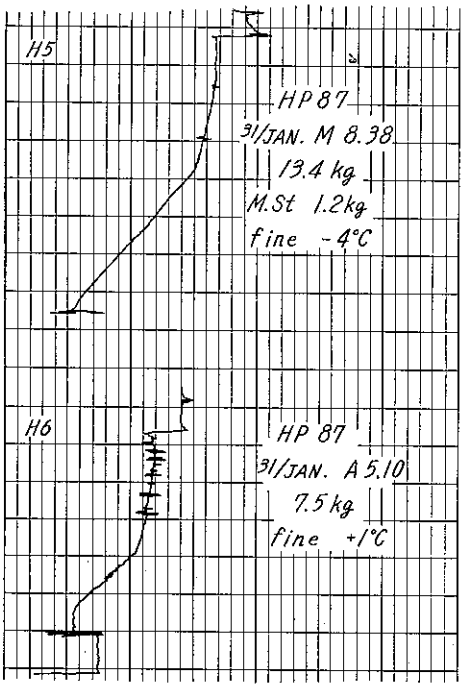
As shown in the Table 4 and 5, 86% of the total milk yield is ejected within 4 minutes after the machine milking was started. In the case of the P 77 67% of the total milk was ejected within 4 minutes.

Milk yields in the afternoon are relatively lower than those in the morning. Most of the milk is ejected within 4 minutes after the milker has started to operate. In both cases, the peak milk flow occurs within 1–2 minutes after milking.

As for the relationships between the physiology of the cow and the mechanical forces of the milking machine, many data are being reported in European countries where the Hydropulse system has been widely expanded. Particularly, the comprehensive principles on the HP 87 milkers are discussed in two symposiums (1, 2). Generally speaking, most of the reports states that the Hydropulse system gives a comfortable feeling to the milk cow and that the effect as such


Milker HP87
H228
Dec. 10, '66
6.40 p.m.
Milk yield 13.3kg
Temp -3.7°C
fine
milking time 9'.30"


Milker P77
H228
Dec. 11, '66
6.45 a.m.
Milk yield 11.0kg
Temp. -7°C
fine, no wind
milking time 13'.10"


H5
HP87
31/JAN. M 8.38
13.4 kg
M.St 1.2kg
fine -4°C
H6
HP 87
31/JAN. A 5.10
7.5 kg
fine +1°C

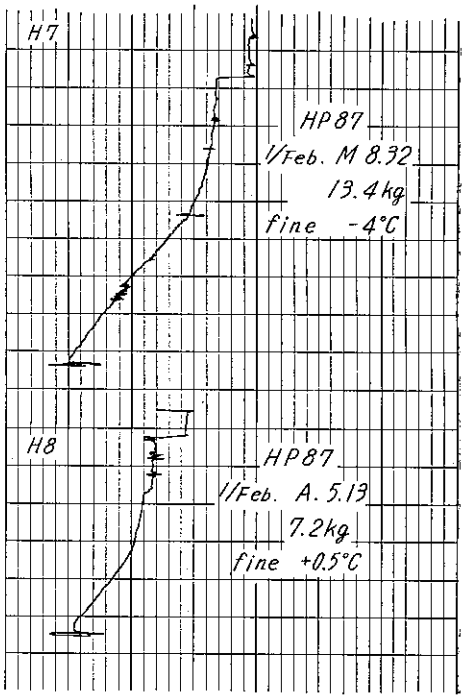
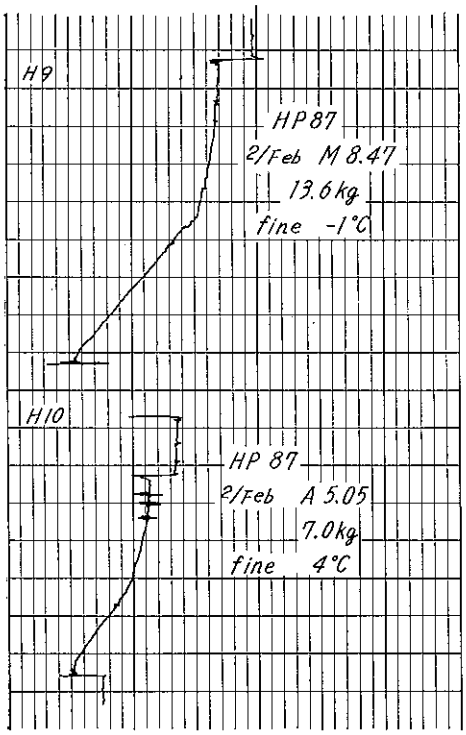

H7
HP87
1/Feb. M 8.32
13.4 kg
fine -4°C
H8
HP87
1/Feb. A. 5.13
7.2kg
fine +0.5°C

Table 4. Milk flow when milking in the morning with random samples (kg)

Type of milker	Time after milking (min.)								
	0–1	1–2	2–3	3–4	4–5	5–6	6–7	8 and more	Total
P 77	1.2	2.4	1.9	1.8	1.5	1.1	0.8	0.7	11.4
	0.6	3.0	2.6	1.8	0	0	1.4	2.1	11.5
	2.1	2.3	1.2	2.4	1.2	0	0	2.6	11.8
Average	1.3 (11)	2.6 (23)	1.9 (16)	2.0 (17)	0.9 (8)	0.3 (3)	0.7 (7)	1.8 (15)	11.5 (100)
HP 87	3.6	3.4	2.8	2.4	1.0	0.5	0.3	0	14.0
	2.4	3.0	2.4	3.0	1.2	1.1	0.1	0	13.2
	2.8	3.0	2.9	3.1	1.0	0.6	0	0	13.4
Average	2.9 (22)	3.1 (23)	2.7 (20)	2.8 (21)	1.0 (8)	0.7 (5)	0.1 (1)	0 (0)	13.3 (100)

Remarks: Numbers within paranthesis mean the comparative values when 100 is the total milk yield.



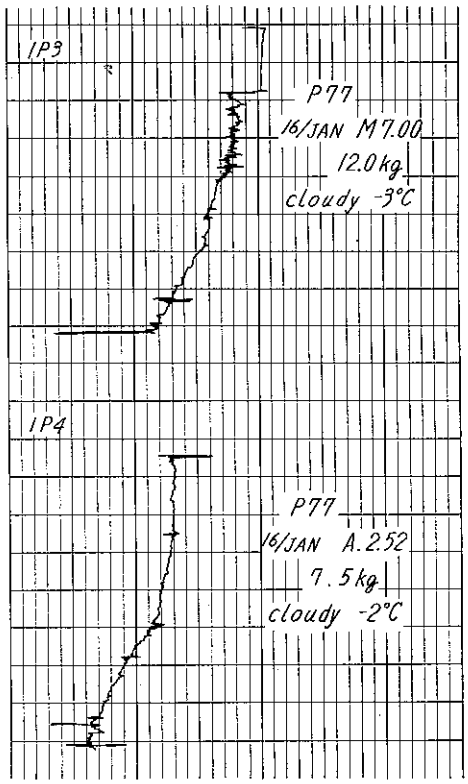
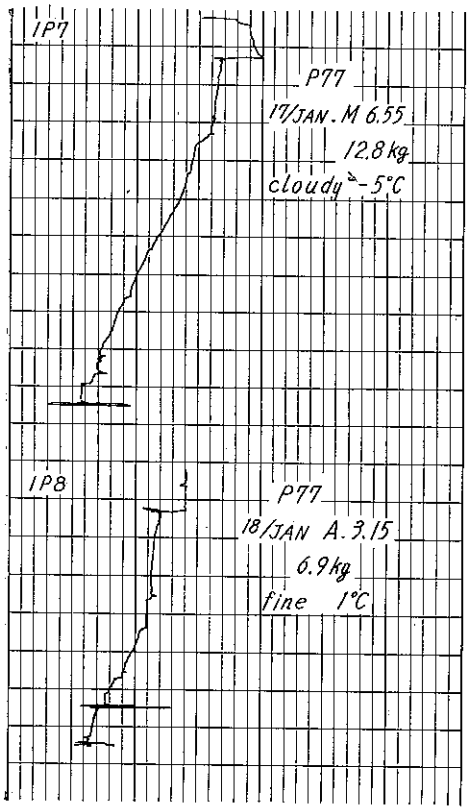
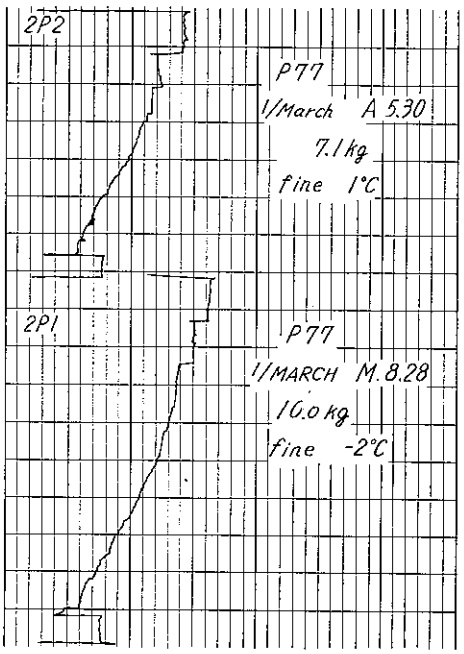


Table 5. Milk flow when milking in the afternoon with random samples (kg)

Type of milker	Time after milking (min.)								
	0–1	1–2	2–3	3–4	4–5	5–6	6–7	8 and more	Total
P 77	1.1	2.2	2.2	1.3	0.7	0.4	0	0	7.9
	1.2	2.5	2.4	0.7	0.3	0	0	0	7.0
	1.5	2.4	1.6	0.3	0.3	0	0	0	6.1
Average	1.3 (20)	2.3 (33)	2.1 (30)	0.8 (11)	0.4 (5)	0.1 (1)	0	0	7.0 (100)
HP 87	1.8	3.0	1.6	0.2	0.5	0	0	0	7.1
	1.6	2.6	1.4	1.2	0.4	0	0	0	7.2
	1.3	3.4	1.7	0.6	0.5	0	0	0	7.5
Average	1.6 (22)	3.0 (42)	1.6 (22)	0.7 (9)	0.4 (5)	0	0	0	7.3 (100)





prevents mastitis, increases the milk yield, lessons the number of leucocyte in the blood and shortens the machine on time. It is said that the action of a reasonable milker for dairy cows is more similar to that of the nursing calf than to the mechanism of hand milking (3).

b) Test made on dairy cows fed on loose barn feed.

Test of two milking parlour milkers are shown as follows.

As shown in the Table 6 and 7, the milk yield with HP 87 increased 10% in comparison with P 77 and this tendency was similar to the result on the test of an individual cow. The comparison of milkers between HP 87, P 77 and one of the domestic milkers carried out at Shirakawa dairy ranch on a large scale with about 200 milking cows which were being fed is shown as follows.

As shown in the below Table, HP 87 indicates an exellent capacity for milking

Table 6. Milk yield and machine on time with P 77 and HP 87

1. Milk yield

P 77			HP 87		
Date	Milk yield per day (kg)	No. of milking cows per day	Date	Milk yield per day (kg)	No. of milking cows per day
Nov. 19	329.6	27	Dec. 9	429.4	33
20	328.4	27	10	396.8	31
21	318.5	27	11	412.6	32
22	311.5	27	12	421.3	33
23	306.9	27	13	414.5	33
24	325.9	27	14	415.9	32
25	318.0	27	15	423.7	32
26	321.7	27	16	417.8	33
27	318.9	27	17	406.8	31
28	336.9	27	18	441.6	32
29	320.7	27	19	425.8	32
30	320.0	27	20	428.0	32
Dec. 1	344.6	28	21	436.5	32
2	344.8	29	22	431.4	32
3	334.2	29	23	418.1	30
4	367.0	30	24	419.9	30
5	394.8	31	25	430.7	30
6	399.0	31	26	417.8	30
7	405.9	32	27	416.3	30
8	411.3	33	28	415.3	30
Average milk yield per day per cow (kg)		12, 10 (100)			13, 37 (110)

2. Milking time with four double Herringbone system

Type of milker	Daytime	Total hours for milking	No. of milking cows	Time for milking per cow	Total milk yield (kg)
P 77	Morning (from 6.30 a.m.)	61′	30	122	257.4
	Afternoon (from 3.30 p.m.)	46′	30	92	171.6
HP 87	Morning (from 6.30 a.m.)	47′15″	24	118	201.6
	Afternoon (from 3.30 p.m.)	28′	24	60	134.4

Table 7. Comparison of milkers between HP 87, P 77 and domestic milker affecting the time required for milking and milk yield

Kinds of milker	Time required for milking (min. sec.)	Remaining average milk yield (kg)
Domestic milker	12′06″(205)	605 (174)
P 77	7 00 (118)	580 (167)
HP 87	5 55 (100)	347 (100)

Remarks: Average milk yield per cow per day is 15.2 kg.

when compared with other milkers. The use of the HP 87 milker required only 5′55″ for milking, 7′ while the P 77 and domestic milker needed 12′06″ and even though they required more time than that of the HP 87 it took less time than other milkers. Considering the above results, it was confirmed that the HP 87 is a better machine for milking.

Summary

The authors are carrying out a series of experiments to decide the proper milking machine under various environmental conditions in Japan. This paper is a report of the comparative study between the P 77 and HP 87 originaly made by Alfa Laval AB, Sweden. This test was carried out during the winter season with both pail and parlour milking machines. The results are summarized as follows.

Type of milker	Type of milking	Total	Milk on machine	Machine stripping
P 77	pail	100	100	100
HP 87	pail	114	123	57
P 77	milking parlour	100		
HP 87	milking parlour	110		

1. The comparative values of milk yield between the P 77 and HP 87 are as follows.

The milk yield with the HP 87 increased about 14% more than that with the P 77 in the test of the pail milking and 10% in the test of milking parlour. Notably, milk from machine stripping decreased sharply with the HP 87.

2. The time necessary for milking with the HP 87 decreased slightly (4%) although the milk yield increased (14%) considerably over that of the P 77. The time for machine stripping had a strong response with both kinds of milkers. The result of the test in the milking parlour was similar with the test of the individual cow.

3. A variation of milk flow per minute occurred with the process of time. Generally, the milk flow within 4 minutes was high and 3–3.4 kg milk was ejected in a period of 1–2 minutes.

4. The comparative study on the milk yield, time necessary for machine milking and the remaining milk after the machine milking were tested with the HP 87, P 77 and a domestic milking machine at large scale dairy farm. The use of the HP 87 was effective in promoting the efficiency of milking which had a positive effect on the milk yield, and decreased the machine on time.

From this research work as shown above, it was recognized that the HP 87 milker has displayed the most efficient service in comparison to other milking machine in both pail and pipe line types of milking.

References

1) Proceedings of Symposium No. 1 On Machine Milking Hamra 12–14, Dec. 1963 1–228 Alfa Laval AB.
2) Problemetik des Maschinellen Milchentzuges, Berlin 28–29, April 1966 Alfa Laval AB.
3) Vearl R. SMITH (1959): Physiology of Lactation 5ed., 155–167.

摘　　要

著者らは，日本のいろいろな環境条件下において適応した搾乳器を選択し，その性能を明らかにするために機械搾乳に関する一連の研究を実施している。今回はスウェーデンアルファラバル会社において製作された旧型の P 77 と新型の HP 87 の搾乳に及ぼす影響について比較研究した結果について報告する。

この研究は，冬季間においてバケット型とミルキングパーラーにて用いたパイプライン型の搾乳器について実施したものである。その結果を要約するとつぎのごとくである。

1. P 77 と HP 87 型のものについて比較した結果は表のごとくである。

以上のように，HP 87 で搾乳するときは P 77 に比してバケット型で乳量が 14%，ミルキングパーラーのパイプライン型で 10%，それぞれ増加した。特に，HP 87 を用いた時には後搾りの乳量がかなり低減した。

ミルカーの型	総産乳量指数	機械搾乳量指数	後搾り乳量指数
P 77 ペール	100	100	100
HP 87 〃	114	123	57
P 77 ミルキングパーラー	100		
HP 87 〃	110		

2. HP 87 を用いた時には，搾乳に要した時間が極端に短縮された。このようにミルカーの種類と後搾りおよび搾乳のための所要時間とはきわめて関係が深い。ミルキングパーラーにおけるパイプライン型の場合もバケット型の場合と同様である。

3. 1分間あたり搾乳に対する産乳量は時間が進むとともに変化するが，一般的にいうと搾乳を始めてから1～2分後に最高となり，この間に3～3.4 kg の牛乳が流出される。

4. 比較的大型な酪農場における HP 87，P 77 と国産搾乳器による搾乳の所要時間および残乳量を調査すると，HP 87 の性能はきわめて高く，機械搾乳に要する所要時間も短縮され残乳量もきわめて少なくなった。

以上のごとく，新しい型式の HP ミルカーはバケット型でもパイプライン型でも産乳量を多くし，機械搾乳に要する時間を短縮せしめ，著しく残乳量を少なくする上に効果があることが確認された。

Res. Bull. Obihiro Univ., **6** (1969): 44~67.

北海道の自然草地における植生の草地生態学的研究

II. 桧山国上ノ国町八幡草地

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Ecological Studies of Vegetation on Natural Grassland in Hokkaido

II. Natural Vegetation on Hachiman Grassland, Kaminokuni Town, Hokkaido

By

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緒　　言

自然草地における北方型植生の生態学的特性を明らかにするため，北海道の各地域において植生調査を実施し，その一端はさきに報告したところである[1]。今回調査した草地は，北海道の南部地域の代表的な自然草地であり，この地帯としては草地面積も広く，利用の歴史も古い[2]。気候的にみると本州の東北型に類似しており，植生も主として短草型のシバ型である。したがって，東北・北海道の植生関係を研究するには好適地の1つである。この研究は1957年に調査を開始し，さらに翌1958年と1968年に実施したが，これは最近の10年間における植生推移を究明し，北海道として比較的温暖な気象条件下にある自然草地の植生を基礎とした草地管理上の諸問題点を明らかにするために実施したものである。

本研究報告にあたり，研究の推進に御指導をいただいた前農林省農林水産技術会議研究調査官加唐勝三氏，現研究調査官仁木巌雄氏，研究遂行上御教示をいただいた九州大学教授江原薫博士，東北大学教授吉田重治博士，千葉大学教授沼田眞博士らに深甚な感謝の意を表するしだいである。

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