

2

Development of ultrasound machine to estimate lean
percentage of live pigs

()

“ ” .

1997. 11.

: ()
:
:
:
:
:
:

:
:

2.

·
(())
, 가 가 ()
가
·
506
, 가가
·

3.

, ()
, 가 B-
가
, 가
,
,
VCR 가
,

1 , 2
가 .
가 1/3 가
가 .
가.

1
2 (2)

·
, (, ,
)
,
가

1 1

·
가
126 7
(, 1997).

2.

가 kg 300 kg 1,800 2,000

가

300 500

가

3. ,

4.

ALOKA 500

PC,

1

4

()

(SONO 600)

PC

1 (가)

가 1 3 가 . ,

, , 가 150

45 가 .

5. 가

가

ALOKA 500 가 가

가 .

SONO 600 1

ALOKA 500 가 30 40%

가 .

Summary

Ultrasound imaging and technology - developed for human medicine - have become potential to evaluate composition and quality of live animals and carcasses. The objectives of the research were to develop a software to convert from live animal measurements to lean meat percentage for swine, and to apply B-mode ultrasound machine with above software to live pig. Five hundred and six live pigs were measured by the ultrasound probes and sacrificed to measure actual lean meat weight to establish regression equations. A ultrasound machine produced in Korea, SONO600 model, has been tested and compared with the equation and other imported ultrasound machines.

The SONO600 model shown as equivalent precision as ALOKA500 model produced in Japan, and better precision to estimate lean percentage of live pigs than another imported A-mode ultrasound equipment of PIGLOG105 produced in Denmark.

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1	(Ultrasound) 가?	17
2	18
3	19
4	23
3	가
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2	가 30
4	 37
1	37
2	1 42
3	2 43
4	1 49

5	2	53
6		(1,2 507)	58
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5		64
1		64
2		(SCAN) ...	64
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6			75
1		75
2		76

<	>	88
---	---	-------	-----------

1

1

1.

가.

○ WTO

가()

가

가

가

가

가

○

가

가

○

가

○

.

○

, 가 가 ()

가

○

()

가

○

가가

2.

가.

○

()

,

.

.

○

가

.

○

.

○

, VCR

.

2

1.

2.

가. 1 :

(1)

. 2 :

(1)

. 3 :

1

(1)

. 4 :

(())

2

(2)

. 5 :

. 6 :

(2)

2

1 (Ultrasound) 가?

(가) 20Hz 20,000Hz

, 가 20,000Hz(20kHz)

(Ultrasound) . 가

3MHz 2cm

3.5MHz 1.92cm, 5MHz 1.34cm .

3MHz 5MHz가

1. (propagation)가 .

, Gas .

2. , .

, , , ,

3. , .

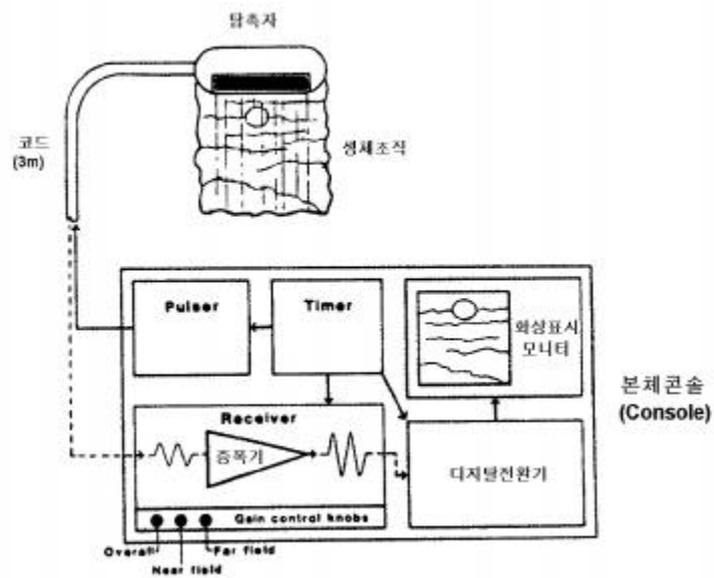
4. 가 , ()

2

1.

(Probe) (Console) 2

(2-2-1).



(2-2-1)

2. (Probe) ()
 (Zircon), (PZT)
 $\oplus\ominus$ 가 ,
 () .
 가 (: piezo
 electric element) . ()
) 가 .
 (transmitter and receiver)
 transducer
 () .
 (probe) 가

3

Transducer 가 ()
 1) (pulse)가 .
 1,530m/s ()
 (가)
 (echo) .

echo ,

가

pulse

1. (Ultrasound Mode)

echo , A-mode

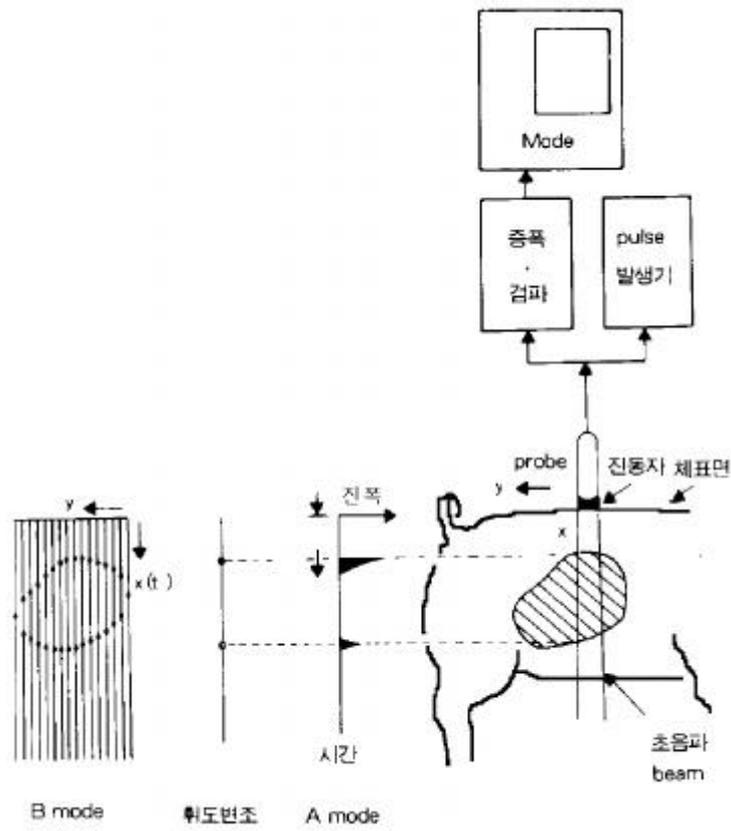
(amplitude-) B-mode (brightness-) 가

A-mode echo가 () ,
echo

(2-3-1).

B-mode echo , echo ,

echo



(2-3-1) Pulse

beam

(X)

(Y)

2

2.

B- Mode beam probe

linear, sector, convex trapezoid

linear

(probe) 가 8 12cm, 15 20mm

가 (probe) 1mm 가

60 140 , 1 120 240

()



scan

(2-3-2).

scanner

scan 1

(2-3-2)

(linear

probe)

가 1

beam

, 8 48

가 1 가

1 beam

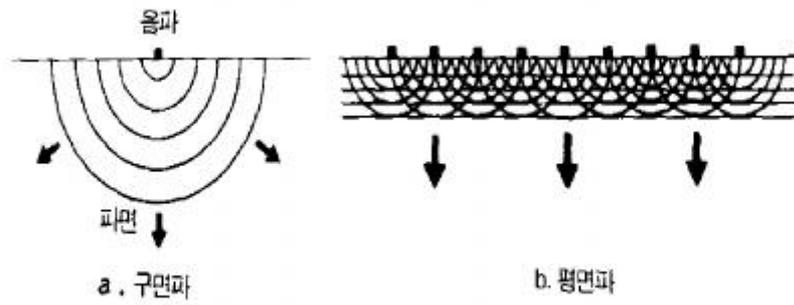
scanner

(: small sized-source of

sonic beam)

가 (2-3-3),

가 1 12
(echo)
scan scan



(2-3-3)

가 1/3 가
real scan
(real time)

(Huygens)

4

pulse

가

- : (가) (
-) .
- :
- :
- : () .

1. (Reflection)

가 .

가. ()

가 . (:

acoustic interface) , 가

. 가
가 () 가
가 가
가 .

2. (Acoustic attenuation)

가
가
가 .
가 ().
가 (),
가
가
가 .
가 가
가
가 .

3 5 MHz 가 15cm 가 .

3. (Velocity Sound)

1,530m
(2-4-1) 가 .

가.

1,530m 가
(scale mark)
(velocity of sound)
scale 가 .

(Image distortion)
가 1,530m/s ,
1,480m/s(3.3%) 5cm
1.6mm .
가 ,

(2-4-1)

	(m/s)
(20)	1,483
	1,750
	1,410 1,479
	1,520 1,591
	1,550 1,607
	1,558 1,568
	1,498
	1,665
	1,571
	1,510

4. (Artifacdtts)

(Multi reflection Reverberation) : beam pulse

echo .

() 가 (true echo)

가 2

2 가 , (reverberation)

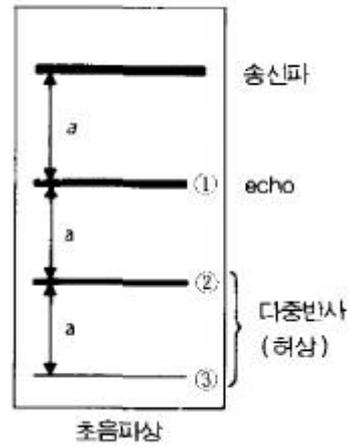
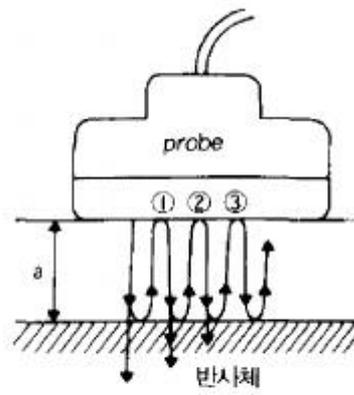
artifact)

(2-4-1).

가

beam

가



(2-4-1)

3 가

1 가

가

가

가

가

,

,

.

가

가

A- mode,

B- mode

가

가

(real- time ultrasound)

가

.

,

, 가

가

(Terry , 1989; Cross Belk, 1994).

가

A - mode 가

, B - mode

1.

가 가

가

가

(尺)(ruler probe)

Hazel Kline(1952) (ruler probe) Depape

Whatley(1956) (lean meter)

, 1.5cm

1

(2.54cm) (DePape Whatley,

1956).

(needle probe method)

ruler prob

가 ultrasonic probe

(Hazel Kline, 1959; Gillis , 1972).

2. A-

A-

()

가

. A- mode 1950

(Hazel Kline, 1959; Simm, 1983),
(Leymaster, 1985; Fortin
Shrestha, 1986).

Whittaker (1992) A-mode scanning

, 가 가

. Cross Belk(1994)

A- mode B- mode scanning , A- mode

가

가 B- mode

3. B- (實時間)

(real- time

ultrasound machine) B- echo digitalize

2

A- mode machine

가 가 가

. 가

real- time ultrasound

가 (Edward , 1989; Forrest , 1989; McLaren , 1989; Terry , 1989; Faulkner , 1990).

가 real-time 1980 , Forrest (1986) 10 가 0.71 0.68 . Lopes (1987) (r=0.75 0.89), 10 (r=0.80 0.89) (r=0.27 0.71) . Real-time ultrasound (Kempster , 1982; Cameron Smith, 1985)가 가 가 . real-time ultrasound , 가 (McLaren , 1991; Moeller Christian, 1993; Sather , 1986).

2 가

가 가

가

가 .

가 .

가

1950

1. (羊)

(羊)

(Carpenter, 1966;

Smith, 1969).

가

가

(Campbell, 1959; Moody

, 1965; Shelton, 1977). Jones (1982)

가

가

. Edwards

(1989)

real-time ultrasound

가

$r=0.59$ $r=0.36$

. Ramsey (1991)

, Leymaster (1985)

가

,

가

Stanford (1995)

,

,

,

,

,

() 가 가
. 가 Kempster(1981)
. Purchas
Beach(1981)
mobile skin
(Leymaster , 1985; Fortin Shrestha, 1986; Edwards , 1989)
, (Jones , 1982; Hamby ,
1986)
. 가
12- 13 , ,
가 40 (Jones , 1982; Leymaster ,
1985; Hamby , 1986; Edwards , 1989) real-time
(Jones , 1982; Leymaster , 1985; Fortin Shrestha,
1986).
가 가 가 .

2.

가 .

(Smith , 1992),

가

(Wilson, 1992).

가

(Brethour, 1992; Smith , 1992)

marbling score (Brethour, 1990; Whittaker , 1992) 가

. Andersen (1983)

가 (B- mode) ,

1

r=0.52 0.81,

r=0.53 0.71 . Faulkner (1990)

12 real- time 가 ,

가 .

(R²=0.42 0.90)

(R²=0.43 0.92) . real- time

ultrasound 12

%, , % 가

. Smith (1992)

12 13

r=0.81,

r=0.43

가

. Houghton(1988)

r=0.42 0.92 r=0.47 0.86

가가

(Henderson-Perry , 1989; Perry , 1989; Stouffer , 1989; Faulkner , 1990).

(1997) B- mode real- time ultrasound

가

,

가

가

가

3.

가

가

가

, 가

가

real- time ultrasound

가

(Forrest , 1986; Lopes , 1987; Orcutt , 1990; Cross Whitaker, 1992).

1950 (Hazel Kline, 1959).

(Depape Whatley, 1956; Hazel Kline, 1959; Urban Hazel, 1965; Ramsey , 1972). Webb(1975) 10 가

. Mersmann(1982) 가 가 가 , Kempster (1982)

가 , 가 3 .

Sather (1982) 가 ,

(r=0.78 0.84). Gresham (1992) (real- time ultrasound) 가 .

, , , ,

(R²=0.75 0.88).

가

가

12 16%

McLaren (1989)

Moeller Christian(1993)

가

가

10

(r=0.82).

10

10

real-time ultrasound가

10

0.8

0.7

Terry (1989)

real-time ultrasound

, 10

가

R²=0.83

$R^2=0.63$. Gresham (1994)
 가
 ,
 (R²=0.78 0.87),
 , 10 가
 가
 McLaren (1989) , (real-time
 ultrasound) 42 2
 ,
 가
 , , 10 0.55, 0.62 0.55
 , () (10)
 r=0.61 .
 가 (Sather , 1982; Robinson , 1992).
 가 ()
 scan (Gresham , 1992). Mersmann
 (1982) 90kg

Forrest (1989) ,
 10 ,
 $R^2=0.63$.
 10 0.89
 , 10 $r=0.60$
 0.58 . Liu Stouffer(1996)
 0.77 0.79
 , Gresham (1992, 1994)
 가
 가
 , 가 .

4

1

1.

가.

1)

가

ALOKA 500 . 가 7
 B M , , 가
 , . 10kg .
 ALOKA 500 (Probe; 15cm)
 . ALOKA 500
 VTR .

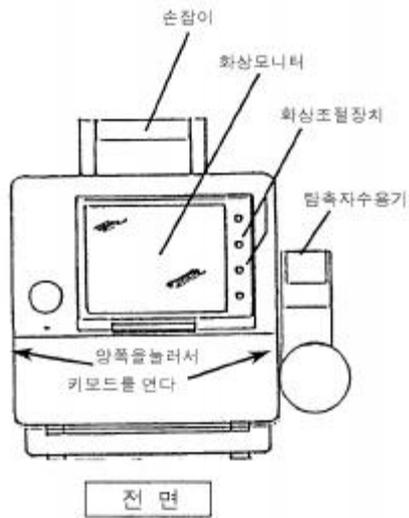
2)

ALOKA 500

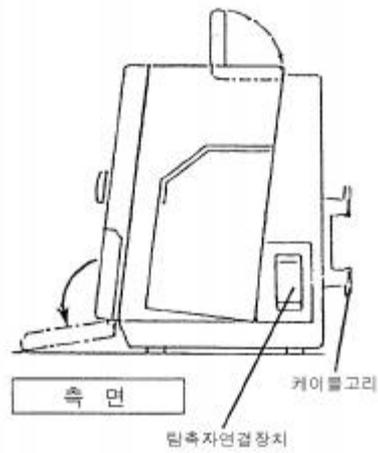
가 .

(Critical Vision Inc.)

「Loin- O- Matic」



(4-1-1)



ALOKA 500

1)

()

SONO 600

ALOKA 500

SONO 600

SONO 600 가

()



(4-1-2)

SONO 600

2)

2.

가.

100kg 115kg

_____ (cm).

_____ (cm).

10

14 15

가

가

4

_____ (cm²).

_____ (%).

(ALOKA 500)

() .

$$\begin{aligned} (\%) = & 3,950 - 0.1397 \times \quad (\text{kg}) - 41.7576 \times \\ (\text{cm}) + & 30.2774 \times \quad (\text{cm}^2) \end{aligned}$$

1)

. , , 4 ,
가 , 10 ,
10 . 4 5

2)

9 1
가
3mm .

가 (Salable lean %)

$$1 = \frac{\quad + \quad + \quad + \quad + \quad +}{\quad}$$

$$2 = \frac{\quad + \quad + \quad + \quad + \quad + \quad + \quad +}{\quad}$$



(4-1-3)

2 1

가. : 230

1) : 96 6/19(), 6/26(), 7/3(), 7/10()

							F1							
	(L)		(Y)		(D)		LY		LYD					
	13	8	10	10	10	10	10	10	76	73	119	28	83	230

2)

,

(Real Time:RT) 10 1

RT

,

.

1) : 6/21(), 6/28(), 7/5(), 7/12()

2) 1 가

3)

() :

8 (, , , , , , ,)

3 , (),

3 2

1. 2 1

가.

- : 97 4/28(), (2 20)

- : 4/30()

- 1 가

.

- : 97 5/6(), 97 5/7()

(3 63 , F1 20 , 30)

- : 5/9()

- 가

.

							F1							
	(L)		(Y)		(D)		LY		LYD					
	7	3	7	3	-	-	-	-	-	-	14	6	-	20
	11	10	10	10	10	12	9	11	16	14	56	32	25	113

.
 - ()
 •
 •
 • (Real Time:RT) 10 1
 •RT
 •
 - ()
 •
 - (200g)()
 • 8 (, , , , , , ,)
 • 3 , • (), •
 .
 - RT (Aloka) , RT
 (Sono- 600)

-
- ()
- 가 1 RT

.
-
•
2 , 1 , 2 , 2
•
1 , 1 , 1
•
2 , 8 , 2

-
•
5 , P&C 2
•
2 , 7 , P&C 2
•
2 , 9 , P&C 2

2. 2 2
가. : 30

• : 97 7/8()

	LYD		
	15	15	30

•

,

(Real Time:RT) 10 1

RT ,

•

• : 7/9()

• 1 가

•

() :

(200g)()

8 (, , , , , , ,)

3 , (),

3. 2 3

가. : 18

• : 97 9/4()

	LYD		
	6	12	18

•

,

(Real Time:RT) 10 1

RT ,

.

• : 7/9()

• 1 가

•

() :

(200g)()

8 (, , , , , , ,)
 3 , (),

4. 2 4

가. : 96

• : 97 10/21()

	LYD		
	50	46	96

•

,

(Real Time:RT) 10 1

RT ,

.

• : 10/23()

• () 가

•

() :

(200g)()

8 (, , , , , , ,)
3 , (),

4 1

1.

			(kg)	(mm)	(cm ²)	(%)	(mm)	¹ (%)	² (%)
		28	109.8	2.7	45.6	39.0	2.8	39.1	39.7
		33	110.1	2.9	44.0	38.1	3.0	39.2	39.9
		61	110.0	2.8	44.7	38.5	2.9	39.2	39.8
F1		10	107.1	3.1	38.9	35.9	3.0	37.8	38.5
		10	111.3	3.0	44.7	37.8	2.9	38.9	39.6
		20	109.2	3.0	41.8	36.9	3.0	38.3	39.0
		73	106.3	3.3	40.2	36.2	3.2	38.7	39.2
		76	103.1	3.1	39.5	36.5	3.1	38.8	39.3
		149	104.7	3.2	39.9	36.3	3.1	38.7	39.3
		230	106.5	3.1	41.3	37.0	3.0	38.8	39.4

2.

(r)

가.

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.16	-0.75	0.89	-0.31	-0.45	-0.47
(cm ²)	1.0	0.65	-0.15	0.85	0.43	0.44
(%)	0.65	1.0	-0.66	0.64	0.57	0.59

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.62	-0.90	0.95	-0.67	-0.84	-0.84
(cm ²)	1.0	0.86	-0.65	0.75	0.73	0.73
(%)	0.86	1.0	-0.89	0.72	0.89	0.89

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.24	-0.86	0.86	-0.55	-0.63	-0.63
(cm ²)	1.0	0.63	-0.30	0.85	0.47	0.46
(%)	0.63	1.0	-0.78	0.79	0.72	0.71

. 1 F1(×)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.19	-0.58	0.84	0.18	-0.69	-0.71
(cm ²)	1.0	0.66	0.03	0.91	0.19	0.18
(%)	0.66	1.0	-0.52	0.60	0.68	0.69

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.15	-0.92	0.94	-0.12	-0.01	-0.02
(cm ²)	1.0	0.63	0.07	0.57	0.64	0.63
(%)	0.63	1.0	-0.66	0.43	0.54	0.55

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.09	-0.66	0.88	-0.04	-0.29	-0.30
(cm ²)	1.0	0.50	0.40	0.83	0.33	0.32
(%)	0.59	1.0	-0.56	0.50	0.41	0.41

3. (1)

가.

$$= 3.950 - 0.1397 \times \quad - 41.7576 \times 10 \quad + \\ 30.2774 \times 10$$

. (2)

1)

$$= 40.55 - 0.044 \times \quad - 1.48 \times \quad + 0.19 \times \\ (R^2=0.38)$$

2)

$$= 44.0 - 0.049 \times \quad - 2.56 \times \quad + 0.19 \times \\ (R^2=0.79)$$

3)

$$= 41.88 - 0.053 \times \quad - 2.32 \times \quad + 0.24 \times \\ (R^2=0.52)$$

4) 1 F1(\times)

$$= 45.3 - 0.017 \times \quad - 2.95 \times \quad + 0.109 \times \\ (R^2=0.60)$$

5)

$$= 32.02 - 0.094 \times \quad - 0.695 \times \quad + 0.344 \times \\ (R^2=0.49)$$

6)

$$= 37.02 - 0.005 \times \quad - 1.309 \times \quad + 0.146 \times$$

(R²=0.21)

5 2

1. 1 (133)

가.

		(kg)	(mm)	(cm ²)	(%)	(mm)	1 (%)	2 (%)
	39/31	104.6	2.5/1.7	36.5/19.1	37.1	1.9	38.5	40.3
	44/27	100.2	2.4/1.6	38.8/19.4	38.5	2.0	39.9	41.6
	83/58	102.3	2.4/1.6	37.8/19.3	37.8	2.0	39.2	41.0
F1	11/-	104.5	2.8/-	36.1/-	36.4	2.2	2.2	37.9
	9/-	122.3	2.9/-	37.9/-	35.6	2.4	38.6	41.0
	20/-	112.6	2.8/-	36.9/-	36.0	2.3	38.2	40.4
	14/13	109.3	3.5/2.2	47.6/23.5	37.3	3.1	38.0	40.1
	16/-	108.6	2.8/2.0	48.8/24.0	39.7	2.7	39.5	41.7
	30	108.9	3.2/2.1	48.3/23.7	38.6	2.9	38.8	41.0
	133	105.3	2.7	43.0	37.7	2.2	39.0	40.9

() Aloka 500 / Sono 600

(r)

1)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.54	-0.26	0.72	0.06	-0.37	-0.35
(cm ²)	1.00	0.54	-0.15	-0.06	0.14	0.18
(%)	0.54	1.00	-0.17	-0.03	0.49	0.49

2)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.15	-0.82	0.56	0.28	-0.54	-0.53
(cm ²)	1.00	0.67	0.16	-0.12	0.27	0.28
(%)	0.67	1.00	-0.33	-0.31	0.53	0.53

3)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.18	-0.62	0.56	0.13	-0.05	-0.10
(cm ²)	1.00	0.60	0.55	0.27	0.50	0.49
(%)	0.60	1.00	-0.02	0.13	0.49	0.53

4) 1 F1(×)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.14	-0.89	0.71	0.38	-0.64	-0.58
(cm ²)	1.00	0.49	0.26	-0.12	0.30	0.34
(%)	0.49	1.00	-0.52	-0.33	0.67	0.63

5)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.06	-0.74	0.67	0.01	-0.38	-0.38
(cm ²)	1.00	0.63	0.11	-0.39	0.34	0.35
(%)	0.63	1.00	-0.50	-0.07	0.55	0.55

6)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.18	-0.82	0.56	0.28	-0.54	-0.53
(cm ²)	1.00	0.67	0.16	-0.12	0.28	0.28
(%)	0.67	1.00	-0.33	-0.31	0.53	0.53

2. 2 2 (30)

가.

		(kg)	(cm)	(cm ²)	(%)	(cm)	(cm ²)	¹ (%)
	15	113.6	3.0/2.5	43.0/44.9	37.1/38.8	3.79	41.8	39.8
	15	112.0	2.8/2.6	40.0/42.3	36.8/38.1	3.53	40.5	40.2
	30	112.8	2.9/2.6	41.5/43.6	37.0/38.5	3.66	41.0	40.0

() ALOKA500 / SONO600 (S/W)

		(cm)	(cm ²)	(%)	(ALOKA)	(ALOKA)	(ALOKA) (%)
(cm)	ALOKA500	0.49	-0.28	-0.61	1.0	-0.45	-0.92
	SONO600	0.42	-0.33	-0.61	0.81	-0.39	-0.76
(cm ²)	ALOKA500	-0.13	0.55	0.38	-0.45	1.0	0.32
	SONO600	0.24	0.17	0.35	-0.27	0.36	0.59
(%)	ALOKA500	-0.43	0.28	0.61	-0.92	0.75	1.0
	SONO600	-0.14	0.15	0.61	-0.70	0.43	0.68

SONO600

S/W

-

(6

)

0.61

.

-

가 0.68

.

-

0.49

0.42

.

-

0.55

0.17

.

-

.

. 2 4 (96)

1)

		(kg)	(cm)	(cm ²)	(%)	(cm)	(cm ²)	¹ (%)
	46	108.3	2.6/2.8	41.4/39.1	38.1/42.4	2.63	41.2	42.4
	50	102.8	2.1/2.3	41.1/37.8	39.8/43.1	2.43	40.7	43.4
	96	105.4	2.33/2.52	41.2/38.4	39.0/42.72	2.52	40.9	42.9

() ALOKA500 / SONO600

2)

		(cm)	(cm ²)	(%)	(ALOKA)	(ALOKA)	(ALOKA) (%)
(cm)	ALOKA500	0.61	-0.23	-0.29	1.0	-0.17	-0.86
	SONO600	0.65	-0.16	-0.29	0.94	-0.10	-0.78
(cm ²)	ALOKA500	0.25	0.82	0.25	-0.18	1.0	0.55
	SONO600	0.18	0.73	0.32	-0.08	0.85	0.42
(%)	ALOKA500	-0.43	0.49	0.41	-0.86	0.55	1.0
	SONO600	-0.42	0.51	0.58	-0.73	0.45	0.87

1.

			(kg)	(mm)	(cm ²)	(%)	(mm)	¹ (%)	² (%)
		67	106.8	2.57	40.0	37.8	2.80	38.8	40.2
		77	104.5	2.63	40.4	38.0	3.04	39.6	40.9
		144	105.5	2.60	40.2	37.9	2.92	39.3	40.6
F1		21	105.8	2.93	37.5	36.2	3.10	37.8	39.2
		19	116.5	2.91	41.4	36.8	2.96	38.7	40.1
		40	113.0	2.93	39.4	36.5	3.03	38.8	40.1
		160	108.3	29.8/2.61	40.2/40.0	37.2/42.4	2.97	39.2	40.8
		163	105.0	2.67/2.25	40.9/38.9	38.1/43.1	2.84	39.7	41.2
		323	106.5	2.81/2.42	40.6/39.4	37.7/42.7	2.90	39.5	41.0
		507	106.6	2.75/2.42	41.2/39.4	37.7/42.7	2.91	39.3	40.8

ALOKA 500/SONO 600

2.

(r)

가.

		(cm)	(cm ²)	(%) ²	(ALOKA)	(ALOKA)	(ALOKA) (%)
(cm)	ALOKA500	0.81	-0.11	-0.52	1.0	-0.12	-0.75
	SONO600	0.63	-0.34	-0.16	0.67	-0.13	-0.56
(cm ²)	ALOKA500	-0.03	0.87	0.29	-0.12	1.0	0.55
	SONO600	0.22	0.73	0.32	-0.08	0.86	0.42
(%)	ALOKA500	-0.11	0.34	0.57	-0.75	0.55	1.0
	SONO600	-0.37	0.51	0.51	-0.73	0.45	0.87

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	-0.10	-0.80	0.66	-0.08	-0.61	-0.65
(cm ²)	1.00	0.64	0.21	0.28	0.29	0.18
(%)	0.64	1.00	-0.30	0.25	0.65	0.62

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.24	-0.58	0.64	-0.05	-0.24	-0.35
(cm ²)	1.00	0.60	0.61	0.50	0.25	0.14
(%)	0.60	1.00	-0.02	0.34	0.46	0.47

. 1 F1(×)

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.12	-0.69	0.60	0.20	-0.63	-0.68
(cm ²)	1.00	0.58	0.37	0.78	0.22	0.07
(%)	0.58	1.00	-0.14	0.39	0.66	0.57

	(cm ²)	(%)	(cm)	(cm ²)	1(%)	2(%)
(cm)	0.15	-0.64	0.71	0.06	-0.16	-0.27
(cm ²)	1.00	0.58	0.30	0.41	0.48	0.39
(%)	0.58	1.00	-0.34	0.26	0.53	0.53

. 97, 96

		(cm)	(cm ²)	(%)	(ALOKA)	(ALOKA)	(ALOKA) (%)
(cm)	ALOKA500	0.80	-0.14	-0.57	1.0	-0.14	-0.79
	SONO600	0.64	-0.34	-0.16	0.67	-0.13	-0.56
(cm ²)	ALOKA500	0.02	0.84	0.31	-0.14	1.0	0.51
	SONO600	0.22	0.73	0.32	-0.08	0.86	0.42
(%)	ALOKA500	-0.59	0.28	0.58	-0.79	0.51	1.0
	SONO600	-0.37	0.51	0.57	-0.73	0.45	0.87

3. 2 (1,2 , 507)

가.

$$\begin{aligned}
 & : \\
 & = 42.91 - 0.016 \times \quad - 2.084 \times \quad - 0.128 \times \\
 & \quad \quad \quad (R^2=0.39)
 \end{aligned}$$

:

$$= 44.12 - 0.079 \times \quad - 0.816 \times \quad + 0.230 \times$$

(R²=0.33)

$$= 47.7 - 0.037 \times \quad - 2.364 \times \quad + 0.075 \times$$

(R²=0.47)

$$= 46.01 - 0.090 \times \quad - 1.427 \times \quad + 0.200 \times$$

(R²=0.30)

. 1 F1(×)

$$= 44.3 - 0.033 \times \quad - 3.372 \times \quad + 0.040 \times$$

(R²=0.46)

$$= 38.81 - 0.058 \times \quad - 1.242 \times \quad + 0.240 \times$$

(R²=0.31)

:

$$= 41.05 - 0.004 \times \quad - 2.008 \times \quad + 0.145 \times$$

(R²=0.38)

:

$$= 44.12 - 0.079 \times \quad - 0.816 \times \quad + 0.230 \times$$

(R²=0.33)

7

- 1 (97.5.7) (87)

	(cm)	(LEA5T) (cm ²)	(%)	
	2.73 ± 0.59	41.2 ± 2.8	38.6 ± 2.14	
ALOKA 500	2.66 ± 0.71	41.0 ± 7.9	38.0 ± 2.47	
SONO 600	1.77 ± 0.44	20.8 ± 3.5	-	

ALOKA 500 :

SONO 600 : ()

- 2 (97.7.8) (30)

	(cm)	(LEA5T) (cm ²)	(%)	
	3.66 ± 0.388	41.0 ± 7.07	39.98 ± 2.46	
ALOKA 500	2.91 ± 0.661	43.58 ± 4.29	36.97 ± 2.43	
SONO 600	2.11 ± 0.379	32.49 ± 3.38	38.47 ± 1.99	

1

- 3 (97.9.5) (18)

	(cm)	(LEA5T) (cm2)	(%)	
	3.66 ± 0.387	44.51 ± 5.85	40.75 ± 1.87	
SONO 600	3.77 ± 0.741	41.01 ± 3.61	-	

1 , 2

- 4 (97.10.21) (96)

	(cm)	(LEA5T) (cm2)	(%)	
	2.52 ± 0.468	40.91 ± 5.45	42.94	
ALOKA 500	2.32 ± 0.594	41.02 ± 4.65	39.00	
SONO 600	2.56 ± 0.544	39.42 ± 4.32	42.13	

5

1

가

가

가

가 가

가

(,)

(,)

가

2

(SCAN)

1. (PROBE) 가
 - 12 cm . (Aloka가 15cm PROBE
 .)
 - 12Cm가 가 PROBE 12Cm PROBE

2. PROBE PAD
 (LINEAR PROBE)
 PAD
 1Cm 3 cm 가
 . (가 PROBE
 가 .)

3.
 - . (,)

4. (FOCUS) 1 cm 15 cm가
 .
 - PAD 15 cm .

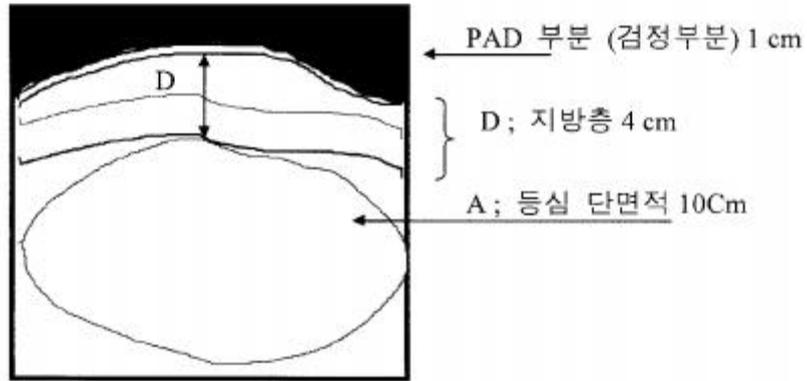
5. PROBE

- 가 가
 PROBE (2MHz ~ 3.5MHz)

(5-2-1)

(Probe)	12 15 cm	.
Probe	2 MHz 3.5 MHz	3 MHz 7.5 MHz
Max. View Depth	15 cm	22 cm, 3.5MHz
() Point	- -	- -
	Near, Middle	Middle, Far

3



(5-3-1)

(1) .

$$\begin{aligned}
 (\%) &= K1 - K2 \times \text{LIVE BODY WEIGHT}(W) - \\
 &K3 \times \text{LIVE 10TH RIB BACKFAT } (D) + \\
 &K4 \times \text{LIVE 10TH RIB LOIN EYE MUSCLE AREA } (A) \\
 &= K1 - K2 \times W - K3 \times D + K4 \times A \quad (1)
 \end{aligned}$$

, K1, K2, K3, K4 ;

W ; (kg)

D ; (cm)

A ; (cm²)

(2) .

$$D = (c \cdot T) / 2 \quad (2)$$

c ;

T ; 가

1) 가 .

(3) .

(5-3-1)

	(cm/usec)
(SA 600)	0.154
(FAT)	0.146

$$E = (1540 - 1460)/1460 * 100\% = 5.479\% \quad (3)$$

(3) 가 3cm

$$3+3*0.05479 = 3+0.16437 = 3.164 \text{ cm} \quad (4)$$

(4) .

가 .

가 3.66cm SA600

2.11cm

가

가

가

1)

2)

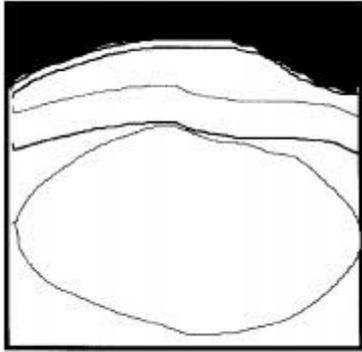
SA600

가 가

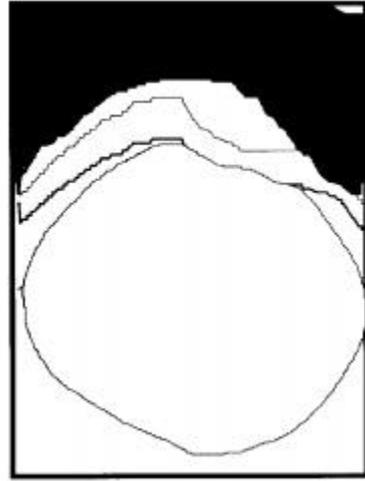
25%

33%

SAMPLING CLOCK



(5-3-2)



(5-3-3)

(가 25% ,
35%)

4

(SONO600)

1.

, 가 ,
가

MEAS\LEAN MENU
 BACKFAT, AREA, WEIGHT, METHOD, EXIT

(5-4-3) Meas

B MODE MEASURE MENU
 DISTANCE, TRACE, ELLIPSE, H.JOINT, VOLUME, LEAN, EXIT

2.

가.

① POWER-ON(BOOTING) → ⑤ Meas → ③ LEAN
 → ④ BACKFAT() → ② AREA() →
 ⑥ WEIGHT() → METHOD()
 *** ④...① .

1) : PC

2) Meas : () , ,

3.

3) LEAN : 2.

4) BACKFAT :

가) GLIDEPOINT BACKFAT
 Select . Select 가

) GLIDEPOINT(TRACKBALL)
 () Select .
) Select 가 (.
) Measure (Meas) .
 가 mm (: D1 =
 30mm).

5) AREA :

가) GLIDEPOINT () AREA
 Select . Select 가
) Select
) Select GLIDEPOINT
 . 가 가 가
 가
) 가 .
 (: C1 = 90mm, A1 = 531mm²)

6) WEIGHT :

가) GLIDEPOINT () WEIGHT

Select .

가) Select 가 .

. (: W = 150kg)

7) METHOD :

가) GLIDEPOINT () METHOD

Select 가 .

) (1) TOTAL AVERAGE, (2) LANDRACE, (3)

YORKSHIRE, (4) F1, (5) DUROC, (6) MARKET HOGS가 .

8) EXIT : GLIDE

POINT EXIT Select .

(CINE MODE)

가

가

. , 가 Freeze

가 Freeze 가

Freeze 가 . 가 Freeze

SA- 600(MEDISON) CINE MODE .

Freeze 3 32
 CINE MODE 32 Freeze GLIDEPOINT
 가.

(BANK MODE)

(Freeze) Freeze . Aloka
 Freeze PC
 PC 가 . SA- 600(MEDISON)
 BANK MODE
 BANK MODE 30 (60)
 POWER()가 24 48

가

Freeze "L"
 GLIDEPOINT

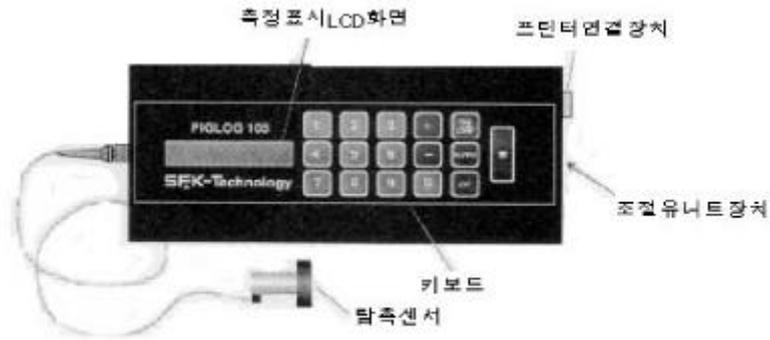
가.

.

6

1

105(PIGLOG 105,)
105 A-
가 750g 가 , LCD
1,000
가



(6-1-1) PIGLOG 105

	105		2	4	97	10	21
()	SONO 600		ALOKA 500				96

2

1.

(6-2-1)

		(cm)	(cm)	2(%)	
	105 (A-)	1.46 ± 0.365	4.7 ± 0.5 (cm))	55.5 ± 3.18 ((%))	3 96 : 105.4kg
	SONO 600 (B-)	2.52 ± 0.568	39.4 ± 4.32 (cm2))	42.9 ± 2.11 ()	
	ALOKA 500 (B-)	2.33 ± 0.594	41.0 ± 4.64 (cm2))	39.0 ± 2.33 ((%))	
		2.52 ± 0.47	40.9 ± 5.45 (cm2))	60.3 ± 2.74 ((%)) 42.9 ± 2.12 ((%))	75.2kg :

B- (ALOKA 500)

B- (

105) . 105

가 2.52cm 58% 1.46cm

가 60.3% 92% 55.5%

B- 가

SONO 600

가 40.9cm² 39.4cm² 3.5%

. ALOKA 500 7.5% 2.33cm,

9.1% 39.0% .

2.

가.A-

105

(6-2-2) 105(A-B) (r)

	(cm)	(cm ²)	(%)	(%)
(cm)	0.60 (P > 0.01)	-0.13	-0.31 (P > 0.01)	-0.50 (P > 0.01)
(cm)	0.13	0.19 (P > 0.10)	0.09	0.13
(%)	-0.56 (P > 0.01)	0.10	0.32 (P > 0.01)	0.52

10

0.60

-0.50

0.19

10%

0.52

SONO 600

(6-2-3) SONO 600(B-

(r)

	(cm)	(cm ²)	(%)	(%)
(cm)	0.64 (P > 0.01)	-0.29 (P > 0.01)	-0.77 (P > 0.01)	-0.45 (P > 0.01)
(cm ²)	0.22 (P > 0.10)	0.73 (P > 0.01)	0.32 (P > 0.01)	0.15
(%)	-0.30 (P > 0.01)	0.59 (P > 0.01)	0.51 (P > 0.01)	0.49 (P > 0.01)

SONO 600

0.64

0.73,

0.51

B-

ALOKA 500

(6-2-4) ALOKA 500(B-

(r)

	(cm)	(cm ²)	(%)	(%)
(cm)	0.64 (P > 0.01)	-0.23 (P > 0.05)	-0.11 (P > 0.01)	-0.33 (P > 0.01)
(cm ²)	0.24 (P > 0.05)	0.82 (P > 0.01)	0.25 (P > 0.01)	0.10
(%)	-0.11	0.49 (P > 0.01)	0.41 (P > 0.01)	0.45 (P > 0.01)

B-

ALOKA 500

0.64,

0.82,

0.41

0.45

A-

B-

B-

(6-2-5)

		105		SONO 600		ALOKA 500	
		(cm)	(%)	(cm)	(%)	(cm)	(%)
SONO 600	(cm)	0.53 (P > 0.01)	-0.77 (P > 0.01)	1.0	-0.77 (P > 0.01)	0.94 (P > 0.01)	-0.77 (P > 0.01)
	(%)	-0.72 (P > 0.01)	0.72 (P > 0.01)	-	1.0	-0.76 (P > 0.01)	0.68 (P > 0.01)
ALOKA 500	(cm)	0.52 (P > 0.01)	-0.75 (P > 0.01)	0.94 (P > 0.01)	-0.76 (P > 0.01)	1.0	-0.86 (P > 0.01)
	(%)	-0.72 (P > 0.01)	0.68 (P > 0.01)	-0.77 (P > 0.01)	0.87 (P > 0.01)	-	1.0

()

105

SONO 600 ALOKA 500

105

SONO 600

0.53, ALOKA 500 0.52

SONO 600 ALOKA 500

0.94

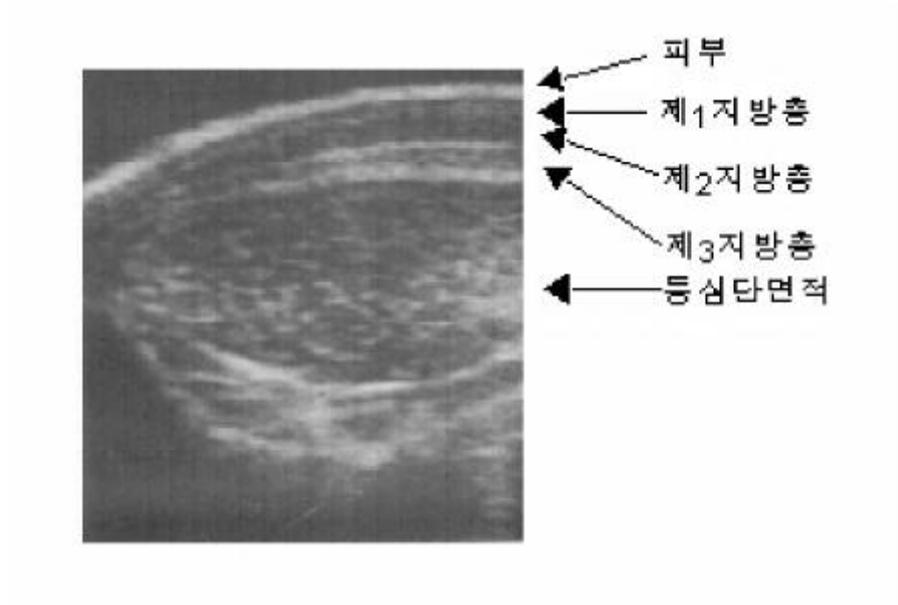
105 , 105
SONO 600 0.72, ALOKA 500 0.68
. SONO 600 ALOKA 500 0.87

. A- B-
A- B-

. A-

가 . B-
가
3

. A-
3 2
가 .



(6-2-1)

B-
가 3 가
3 가
3 가 20%
A- A-
B- 58%

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