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The Effect of Keel Length Upon Reproductive Performance in Broiler Breeders

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to

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Introduction

Broiler breeders are usually grown with an intent of reproductive efficiency. Over the past several years, attention has been focused upon maximizing bird weight to maximize efficiency. With broiler breeder males, experimentation has been conducted to determine the effects of crude protein intake upon both bird size and semen output (Wilson *et al.*, 1987). Numerous times, scientists have verified that lowering crude protein intake does not adversely affect the semen production of the males. Concurrently, hens were tested to determine if a lower crude protein intake would decrease egg production or egg quality: again, no decrease in efficiency was noted (Spratt and Leeson, 1987). Leeson and Summers (1984) determined that although feed lower in crude proteins does decrease the weight, shank length, and keel length at 21 days, the standard restricted feed diets, fed to all birds thereafter, nullify any variations by maturity.

Of primary concern in this experiment is the potential benefit of selecting for or against keel length in broiler breeders. Keel length has a heritability of .36 (Crawford, 1990); therefore, if keel length affects the reproductive ability of broiler breeders, the potential exists to breed for a desired keel length.

Thus the potential exists for a combination of the dietary and genetic information currently available. If keel length, a heritable trait, influences the reproductive efficiency of broiler breeders, then, in the future, this trait can be selected for. The knowledge that the limited dietary intake afforded broiler breeders from 20 weeks of age on, nullifies any physical differences found at younger ages, could allow breeders to maintain the quantity in restricted feed diets and expect better reproductive efficiency.

Materials and Methods

Two thousand day old Arbor-Acres broiler breeder chicks were initially procured for this experiment: 1700 females and 300 males. Of the original population, nine hundred females and three hundred males were selected for use. The flock was reared at the Louisiana State University Research Farm, on a slat and litter-floor and fed in accordance with the Arbor Acres' breeder manual. The birds were vaccinated against Marek's disease, fowl pox, Newcastle disease, and avian encephalomyelitis. At 18 weeks of age, the flock was divided into 7 groups. One of these groups was the control group, which consisted of random birds to demonstrate an appropriate cross-section of the population. The remaining birds were divided into 3 groups by weight in grams: light <1760, average 1760 - 2050, and heavy >2050. These 3 groups were then subdivided into 2 groups each, giving 6 groups. This division was based upon an appropriate keel length in millimeters for each weight division: light - 128, average - 134, heavy - 141.

At 20 weeks, the hens were moved to an experimental laying house with shavings for litter. Seven replications of 18 birds of each treatment were placed in 49 pens, each measuring 1.524 X 3.048 meters. Two random males were placed into each pen. Each pen contained 2 hanging type tube feeders, 1 Little Giant waterer, and 2 four-holed nests. All of the birds were grown to 60 weeks of age and were fed based upon the growth development curve of the control group. Extra males were maintained for replacement purposes.

The eggs were collected and recorded daily. The variables examined in the experiment were egg production, fertility, and hatchability. Every 4 weeks, eggs were saved for 1 week and stored in a cooler (16 C) until they

were set. Eggs were removed from the cooler and allowed to reach room temperature before being set in the incubator (Robbins, model 14I). Excessively dirty, misshapen, or cracked eggs were not set. Eggs were candled after 7 days of incubation in order to determine fertility. Infertile eggs and those containing dead embryos were removed and discarded. After 18 days of incubation, the eggs were transferred to the hatcher (Robbins, model 10H). After 4 days in the hatcher, the number of chicks, pipped eggs, and unhatched eggs were recorded. Fertility and hatchability were calculated.

Data were analyzed using a 3 X 2 factorial arrangement of treatments in a randomized block design. All data were analyzed by the PROC ANOVA and PROC GLM procedures of the Statistical Analysis System (Barr *et al.*, 1979) and according to the procedures set forth by Ott (1993). Duncan's multiple range test (Barr *et al.*, 1979) was used for separating the means.

Results and Discussion

Body weight during the experiment is shown on Table 1. The body weight of the 4 groups became more similar with time. By week 60, all groups weighed the same amount (3.8 kg) except the heavy group, which actually weighed less (3.7 kg).

Egg production during the experiment revealed significant differences between the long and short keeled birds during weeks 29-40 and 45-52 (Table 2). During these weeks, the long keeled birds produced more eggs than the short keeled birds (Figure 2). The statistical differences between the weight groups varied greatly during the experiment. The heavy birds came into production earlier than the other groups, but also dropped in production earlier. The average weight group consistently out-produced the light group throughout the 35 weeks (Figure 1).

The fertility of the eggs laid by the broiler breeders seemed totally independent of keel length and body size (Table 3). The heavy birds demonstrated significantly decreased fertility for weeks 56 and 60. Aside from this trend, no significant variation was revealed between the three weight groups (Figure 3). Although the hens with a longer keel length generally demonstrated higher fertility, there was never any statistical difference between the two keel length groups (Figure 4.)

The fertile hatchability of the eggs revealed no statistical differences between any of the groups (Table 4). There were, in fact, no subtle trends apparent between the weight groups (Figure 5). The separation of birds by keel length also lacked any nuances by which to differentiate the two groups (Figure 6).

The total hatchability curve for the eggs of the various groups mirrored the fertility curve (Table 5). Aside from the significant decrease in total hatchability of eggs from the heavy group in weeks 56 and 60, there were no differences or consistent trends among the groups (Figure 7). The total hatchability with respect to keel length group revealed no differences for any week of the trial (Figure 8).

Thus, it may be concluded that the effect of keel length upon broiler breeders is limited. The increased egg production offers the potential for improvement in the broiler business; however, the lack of improvement in other areas as an effect of keel length demonstrates the limited improvements possible through genetic breeding for keel length. Further experiments should be conducted to determine the precise extent of increases in egg production as an effect of keel length.

Table 1. Body weight distribution of broiler breeders (Kg)

Weight Group	Weeks of Age 20	28	36	44	52	60
Control (Random)	1.9	3.4	3.5	3.6	3.7	3.8
Small	1.6	3.3	3.4	3.6	3.8	3.8
Average	1.9	3.4	3.4	3.5	3.7	3.8
Heavy	2.2	3.6	3.6	3.6	3.7	3.7

Table 2. Egg production of broiler breeders as influenced by body weight and keel length

Treatment	Weeks of Age 25-28	29-32	33-36	37-40	41-44	45-48	49-52	53-56	57-60
Control	29.3	68.2	77.8	76.8	73.0	72.2	68.7	64.5	61.3
Light-Long	20.9	61.0	72.1	69.3	65.4	65.2	60.9	58.2	57.1
Light-Short	20.1	62.5	71.6	68.4	66.7	65.4	56.5	58.9	56.9
Average-Long	29.7	80.6	82.6	79.8	75.9	72.9	69.1	61.1	60.0
Average-Short	32.9	73.6	82.0	76.7	72.4	71.6	60.3	58.2	56.9
Heavy-Long	43.9	87.0	86.0	69.5	65.1	64.9	63.3	57.2	54.2
Heavy-Short	41.7	80.4	81.1	67.7	62.0	59.2	58.1	54.8	52.8
Light	29.5^{C}	61.8^{C}	71.9^{B}	68.9^{B}	66.0^{B}	65.3^{A}	58.7^{A}	58.6^{A}	57.0^{B}
Average	31.3^{B}	77.1^{B}	82.3^{A}	78.3^{A}	74.1^{A}	72.2^{A}	64.7^{A}	58.6^{A}	58.5^{B}
Heavy	42.8^{A}	83.7^{A}	83.5^{A}	68.6^{B}	63.5^{B}	62.0^{A}	60.7^{A}	56.0^{A}	53.5^{A}
P of F	0.0001	0.01	0.05	0.04	0.04	0.08	0.07	0.13	0.05
Long	31.5^{A}	76.2^{A}	80.2^{A}	72.9^{A}	68.8^{A}	67.7^{A}	64.4^{A}	58.8^{A}	57.1^{A}
Short	31.6^{A}	72.2^{B}	78.2^{B}	70.9^{B}	67.0^{A}	65.4^{B}	58.3^{B}	57.3^{A}	55.5^{A}
P of F	0.98	0.02	0.05	0.05	0.06	0.05	0.03	0.08	0.09

Table 3. Fertility of broiler breeders as influenced by body weight and keel length

Treatment	Weeks of Age 32	36	40	44	48	52	56	60
Control	93.0	90.6	93.2	90.4	88.6	85.2	83.0	82.1
Light-Long	96.8	92.7	90.6	90.6	90.5	83.4	82.1	83.3
Light-Short	93.8	94.1	92.9	91.3	89.4	88.4	84.1	81.7
Average-Long	96.4	93.4	88.6	89.2	88.1	82.7	83.9	83.8
Average-Short	93.6	93.6	92.1	92.7	94.3	86.6	84.0	82.0
Heavy-Long	94.4	91.4	93.8	92.8	91.7	82.6	77.3	71.9
Heavy-Short	94.3	93.2	92.6	91.0	88.8	82.0	76.6	71.8
Light	95.3^{A}	93.4^{A}	91.8^{A}	91.0^{A}	89.9^{A}	85.9^{A}	83.1^{A}	82.5^{A}
Average	95.0^{A}	93.5^{A}	90.4^{A}	91.0^{A}	91.2^{A}	84.7^{A}	84.0^{A}	82.9^{A}
Heavy	94.4^{A}	92.3^{A}	93.2^{A}	91.9^{A}	90.3^{A}	82.3^{A}	77.0^{B}	71.9^{B}
P of F	0.46	0.85	0.38	0.86	0.79	0.22	0.04	0.03
Long	95.9	92.5	91.0	90.9	90.1	82.9	81.0	79.7
Short	93.9	93.6	92.6	91.7	90.8	85.7	81.6	78.5
P of F	0.14	0.56	0.35	0.58	0.64	0.18	0.77	0.48

Table 4. Fertile Hatchability of broiler breeders as influenced by body weight and keel length

Treatment	Weeks of Age 32	36	40	44	48	52	56	60
Control	94.0	95.6	90.6	92.1	90.2	91.9	89.3	88.5
Light-Long	95.2	93.8	92.1	92.1	90.6	91.3	89.5	88.4
Light-Short	93.8	94.5	91.2	91.0	90.4	92.3	89.3	86.8
Average-Long	94.2	96.2	92.0	91.5	91.5	93.9	89.6	86.7
Average-Short	92.1	94.4	90.7	90.6	91.0	91.5	88.4	86.2
Heavy-Long	93.8	97.5	90.2	90.6	90.5	92.6	88.0	85.0
Heavy-Short	96.4	95.3	90.1	90.2	90.3	93.9	89.8	86.7
Light	94.5	94.2	91.7	91.6	90.5	91.8	89.4	87.6
Average	93.2	95.2	91.4	91.0	91.3	92.7	89.0	86.5
Heavy	95.1	96.4	90.2	90.4	90.4	93.2	88.9	85.9
P of F	0.50	0.33	0.89	0.76	0.63	0.75	0.67	0.36
Long	94.4	95.8	91.4	91.4	90.9	92.6	89.0	86.7
Short	94.1	94.7	90.7	90.6	90.6	92.6	89.2	86.6
P of F	0.71	0.36	0.35	0.44	0.87	0.98	0.83	0.87

Table 5. Total Hatchability of broiler breeders as influenced by body weight and keel length

Treatment	Weeks of Age 32	36	40	44	48	52	56	60
Control	87.4	86.4	85.2	82.4	81.3	77.8	74.6	74.7
Light-Long	91.5	87.1	84.0	82.9	82.1	75.2	74.9	74.8
Light-Short	87.6	88.8	84.6	82.8	81.4	80.1	76.6	71.5
Average-Long	91.3	89.8	81.4	82.1	81.7	77.3	74.7	72.6
Average-Short	86.3	88.5	83.7	82.3	86.3	78.2	74.2	71.1
Heavy-Long	88.6	89.1	84.7	81.9	83.4	76.5	68.3	61.1
Heavy-Short	91.0	88.8	83.5	81.3	82.0	76.0	67.2	60.8
Light	89.6^{A}	88.0^{A}	84.3^{A}	82.9^{A}	81.8^{A}	77.7^{A}	75.8^{A}	73.2^{A}
Average	88.8^{A}	89.1^{A}	82.6^{A}	82.2^{A}	84.0^{A}	77.8^{A}	74.5^{A}	71.9^{A}
Heavy	89.8^{A}	89.0^{A}	84.1^{A}	81.6^{A}	82.7^{A}	76.3^{A}	67.8^{B}	61.0^{B}
P of F	0.31	0.90	0.41	0.49	0.30	0.83	0.04	0.04
Long	90.5	88.7	83.4	82.3	82.4	76.3	72.6	69.5
Short	88.3	88.7	83.9	82.1	83.2	78.3	72.7	67.8
P of F	0.22	0.98	0.48	0.81	0.73	0.27	0.83	0.29

Figure 1. Egg Production of broiler breeders as influenced by body weight

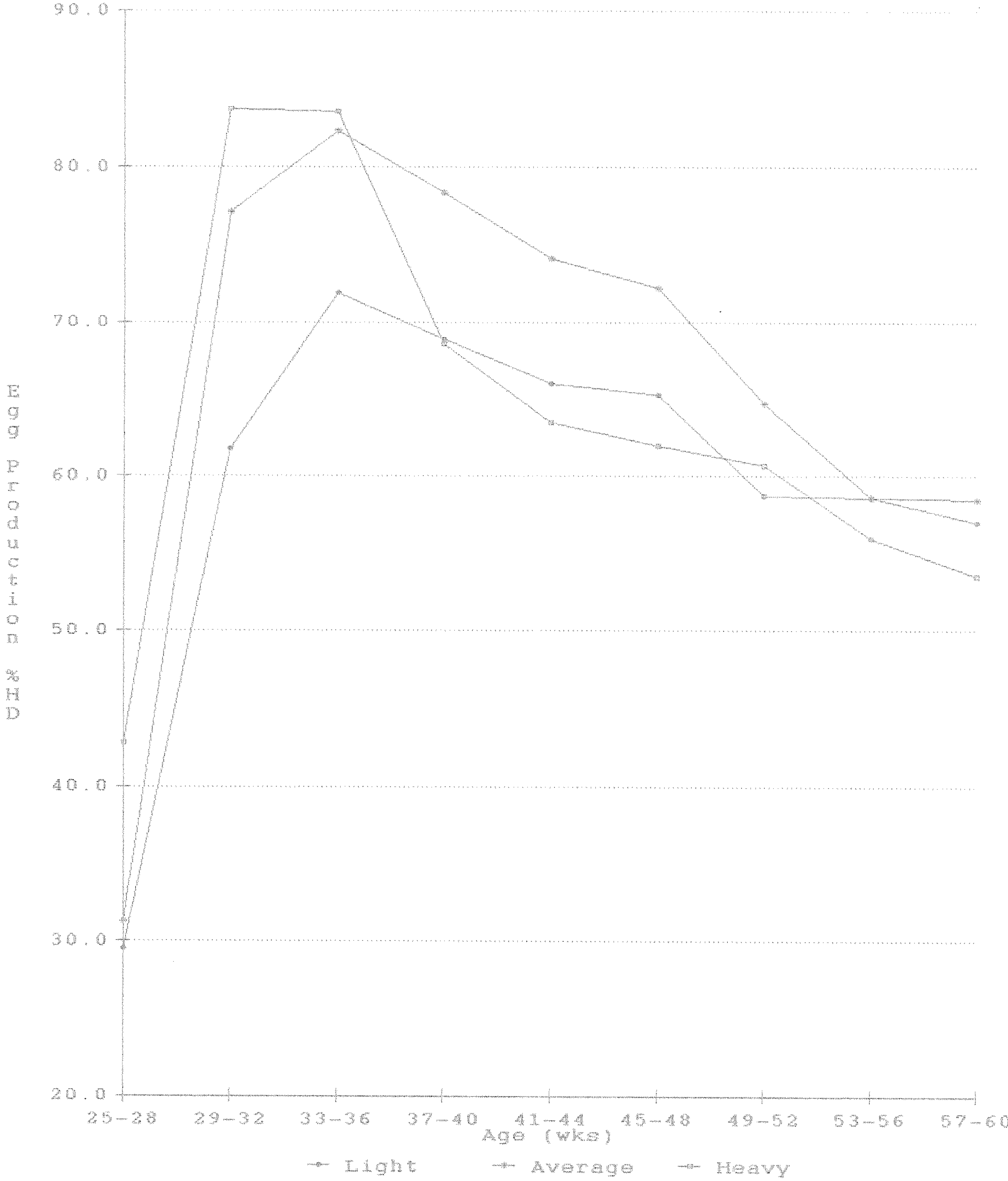


Figure 2. Egg Production of broiler breeders as influenced by keel length

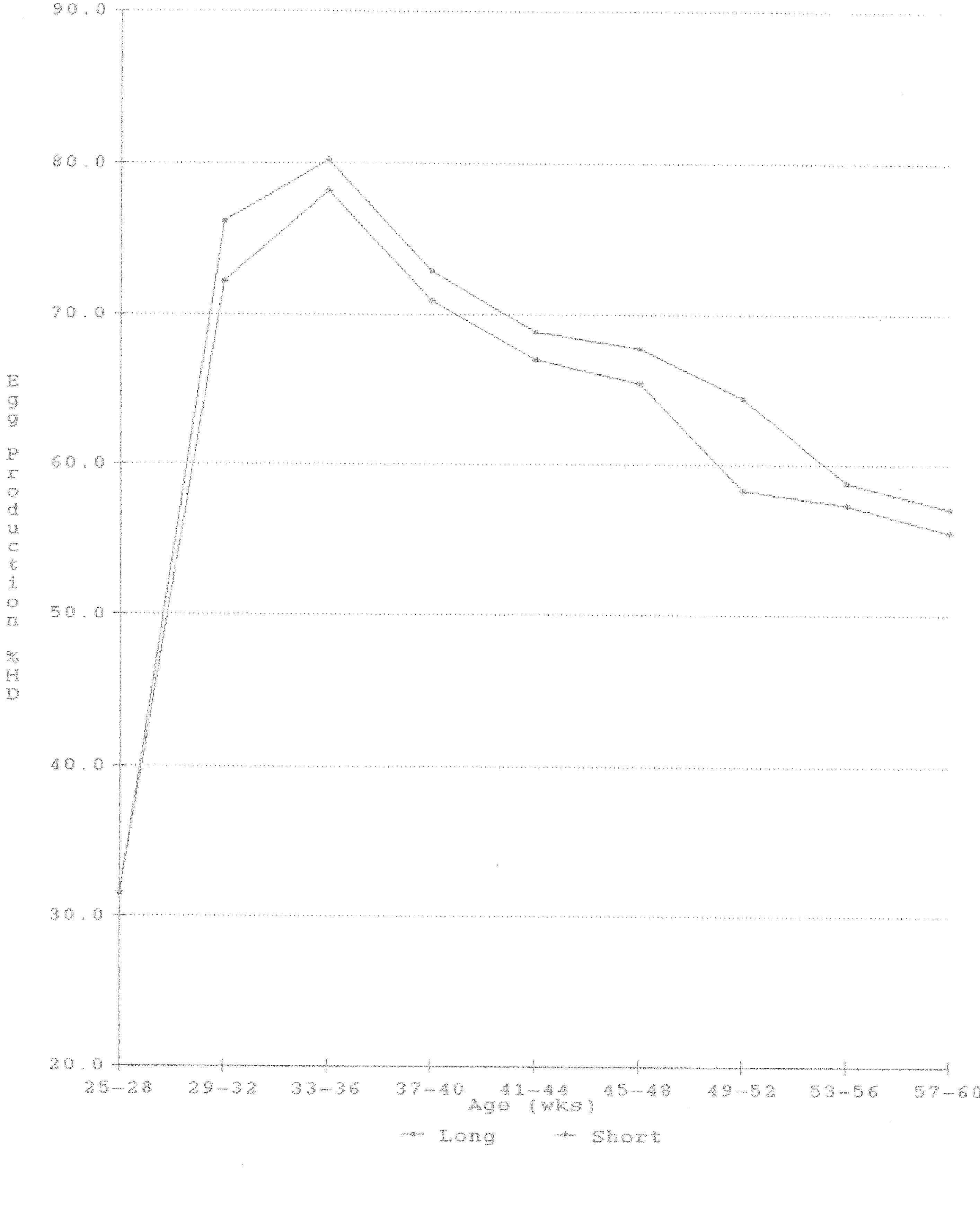


Figure 3. Fertility of broiler breeders as influenced by body weight

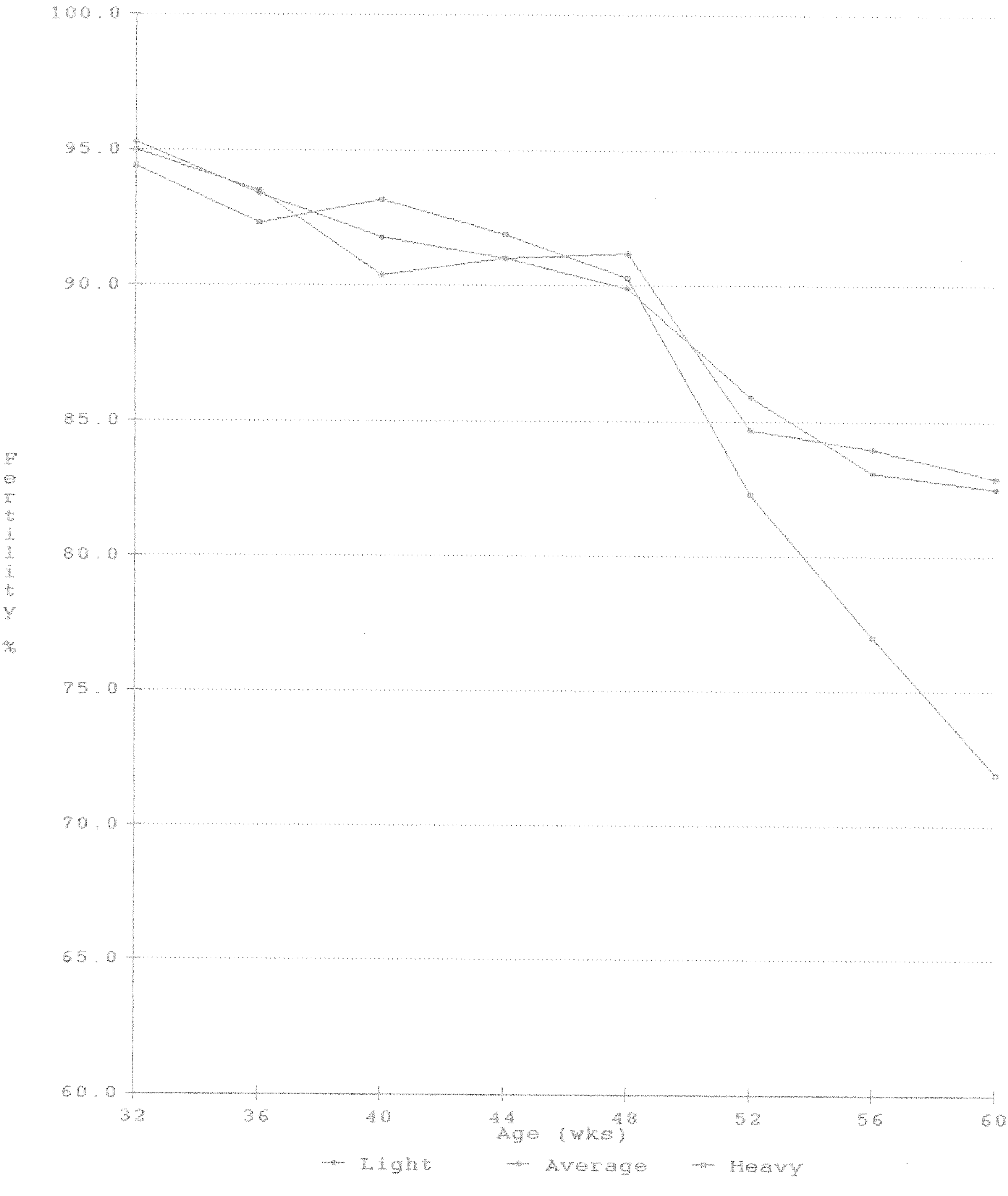


Figure 4. Fertility of broiler breeders as influenced by keel length

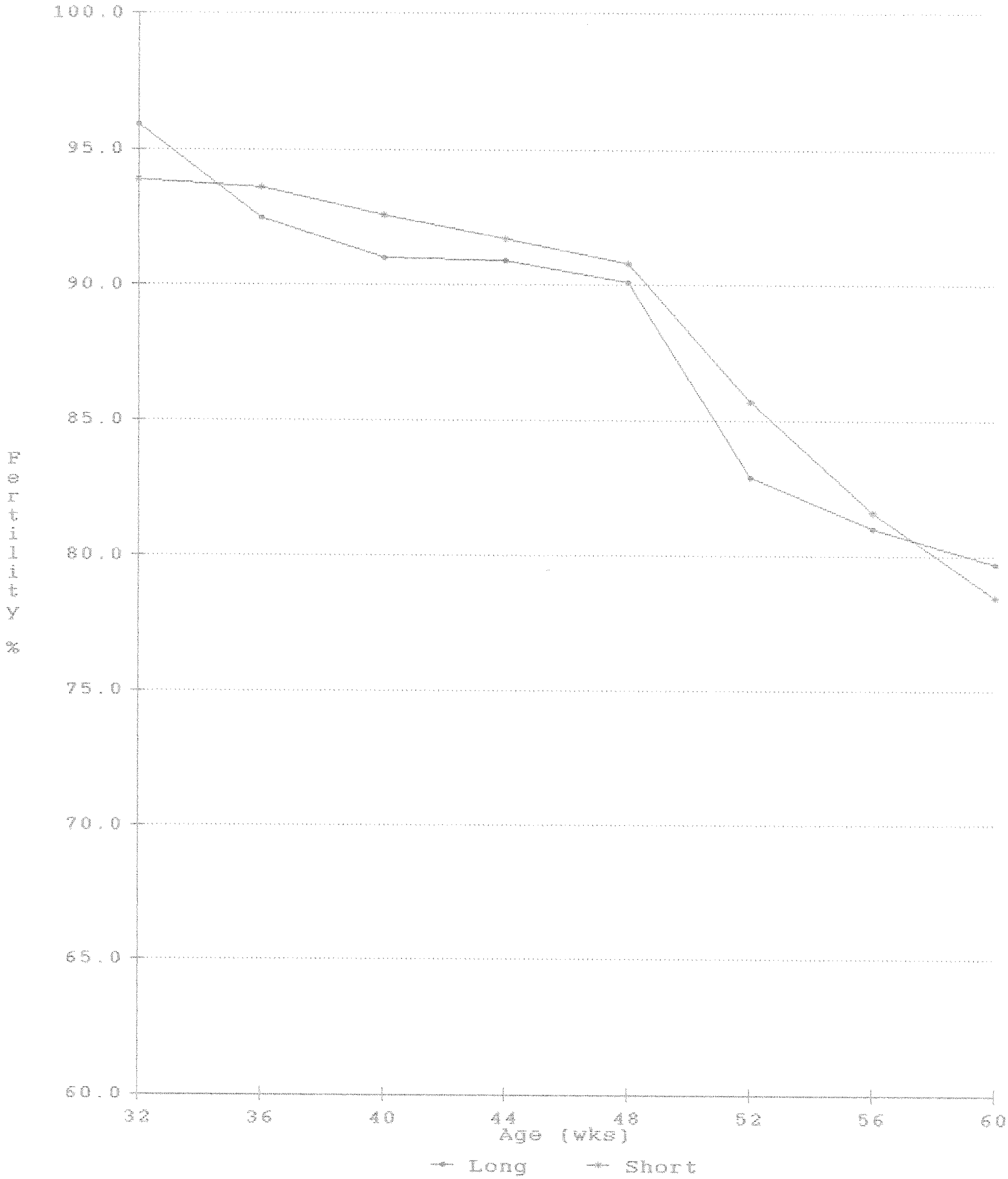


Figure 5. Fertile Hatchability of broiler breeders as influenced by body weight

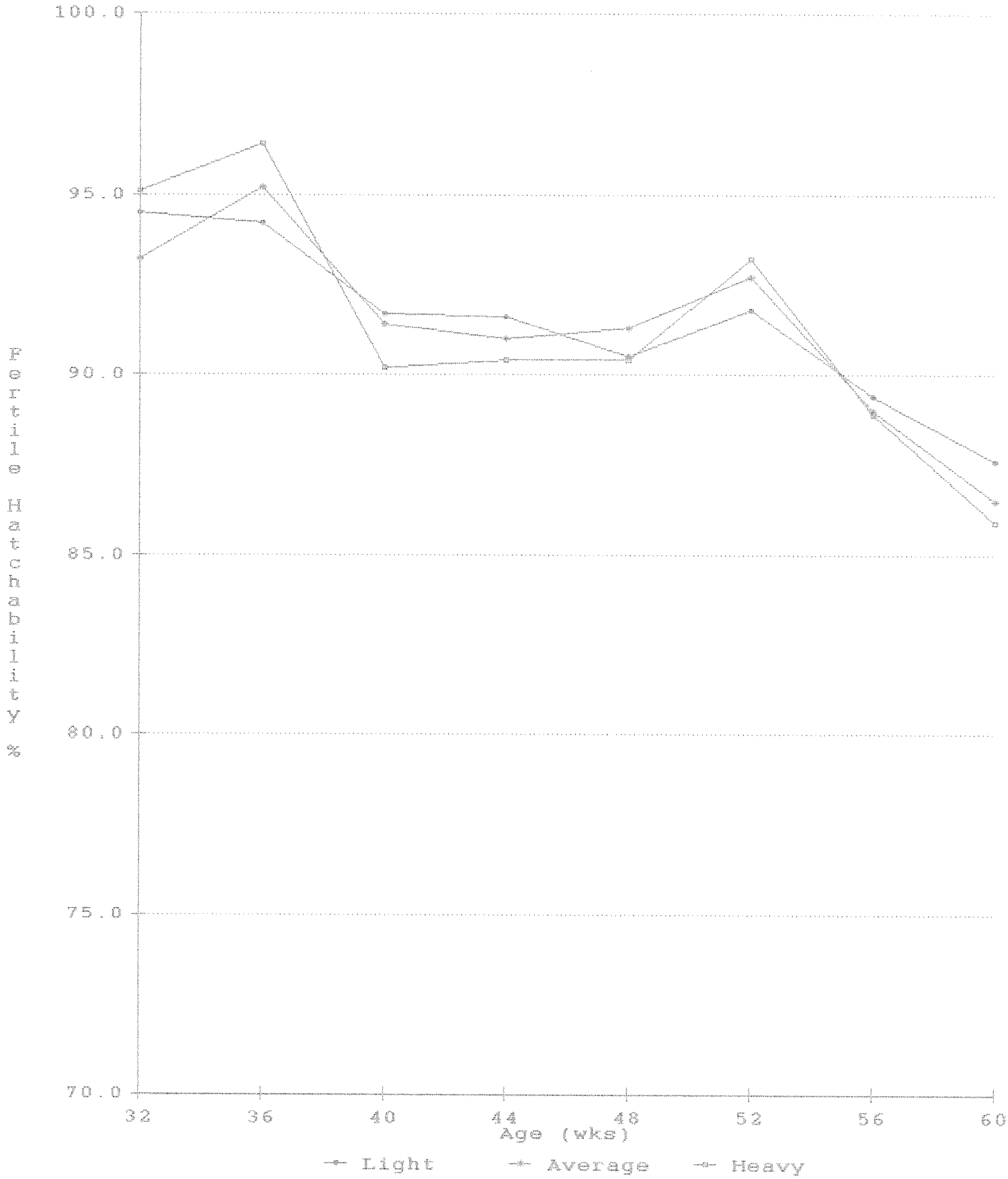


Figure 6. Fertile Hatchability of broiler breeders as influenced by keel length

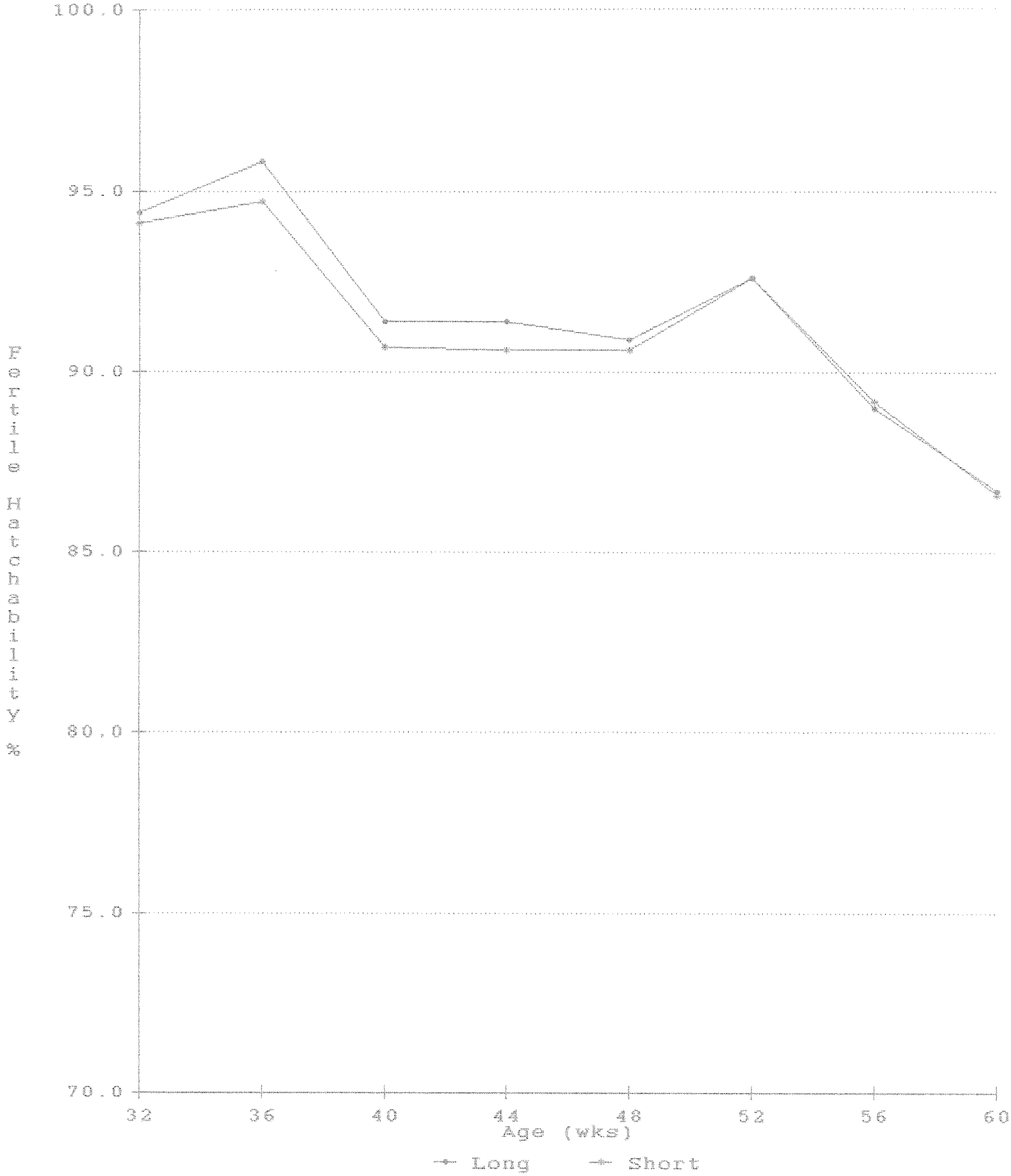


Figure 7. Total Hatchability of broiler breeders as influenced by body weight

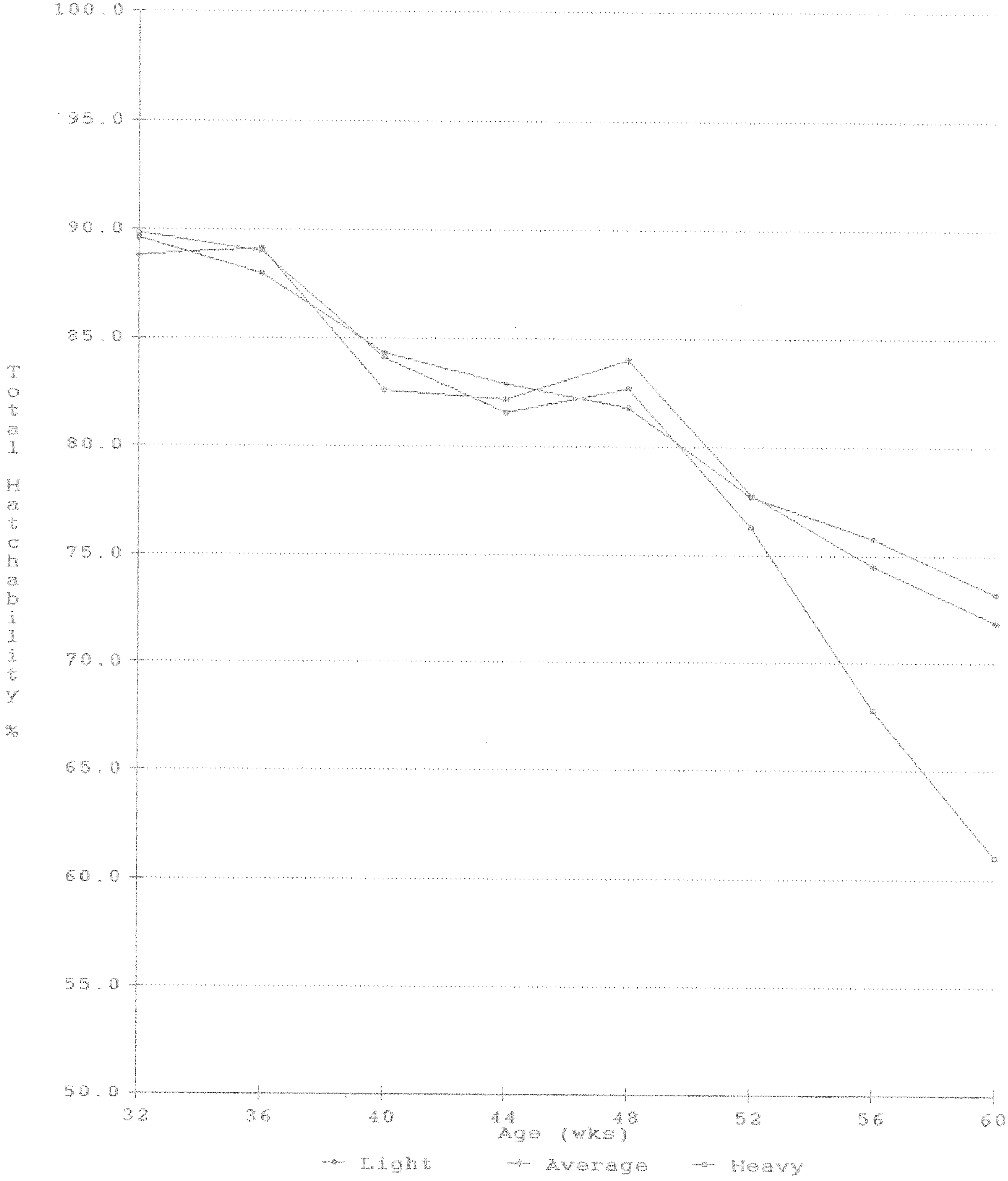
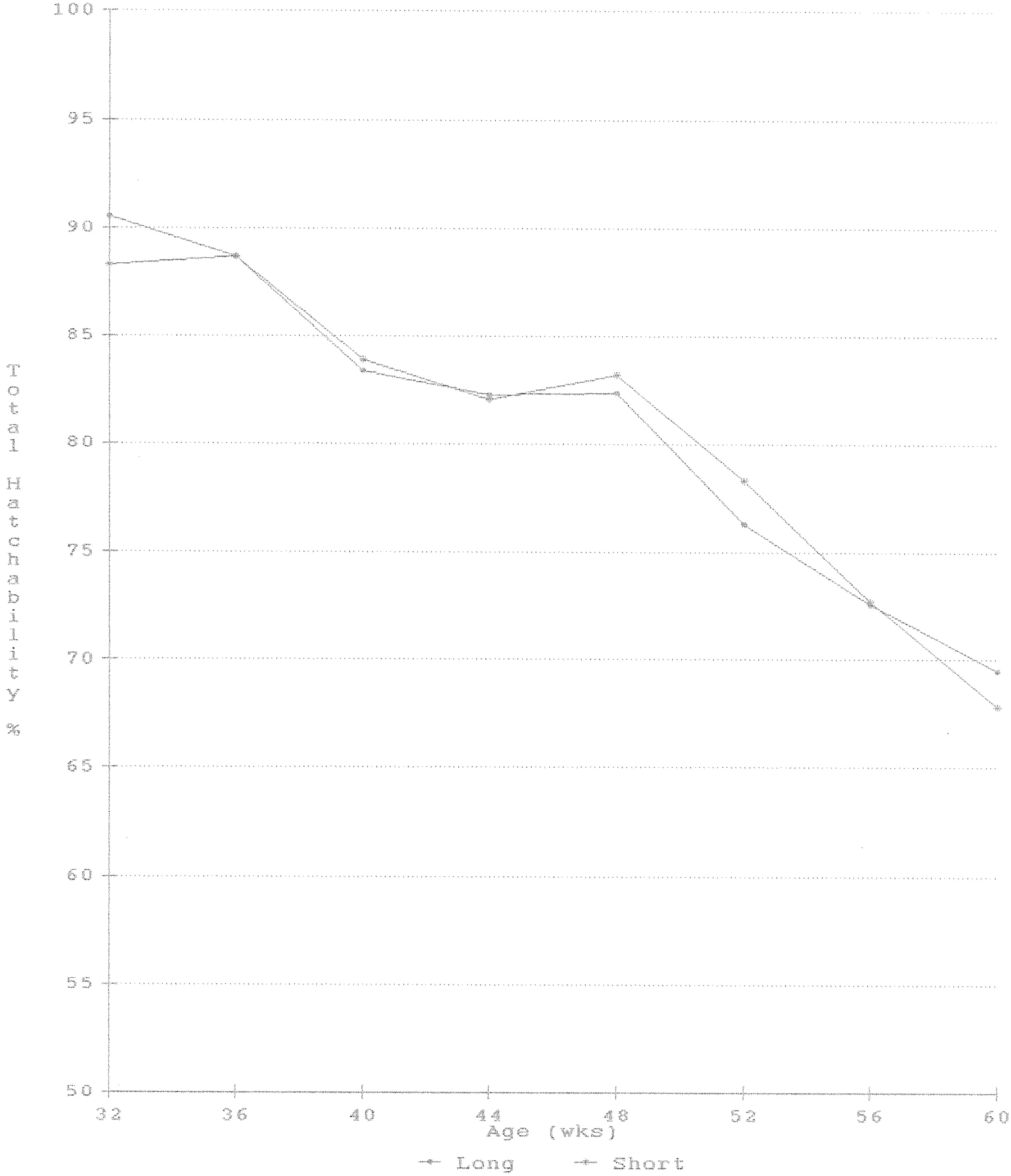


Figure 8. Total Hatchability of broiler breeders as influenced by keel length



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