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(54) Titre : EFFET BENEFIQUE DE DRECHES DE DISTILLERIE POUR SUJETS ATTEINTS DE MALADIES
CARDIOVASCULAIRES
(54) Title: BENEFICIAL EFFECT OF DISTILLER'S GRAIN IN CARDIOVASCULAR DISEASE

(57) **Abrégé/Abstract:**

The use of a food portion comprising dry and/or wet distiller's grain for preventing, treating or ameliorating cardiovascular pathologies is described.



ABSTRACT

The use of a food portion comprising dry and/or wet distiller's grain for preventing, treating or ameliorating cardiovascular pathologies is described.

BENEFICIAL EFFECT OF DISTILLER'S GRAIN IN CARDIOVASCULAR DISEASE

FIELD OF THE INVENTION

The present invention relates generally to the field of nutritional supplements.

5 More specifically, the present invention relates to a feed supplement.

BACKGROUND OF THE INVENTION

Death as a result of cardiac arrhythmia is an increasing concern in feedlots, especially in fast-growing livestock. Given that most feedlots operate on a slim profit margin, losses of livestock are devastating. Many treatments have been proposed, including supplementing feed with calcium or omega-3 fatty acids.

Distiller's grain by-products are the residual mash remaining after the starch has been extracted, converted to sugar and fermented into ethanol and carbon dioxide. Wet distiller's grain is a whole stillage product, with 10-20% solids. It consists of the entire solids and water left after the alcohol has been removed from the mash but is costly to transport and has a short shelf life. Dry distiller's grain (DDG) is typically prepared by drying wet distiller's grain.

US Patent 6,355,456 teaches an integrated process for fermenting grain to produce ethanol and then feeding the by-product of wet distiller's grain to livestock,

among other steps. This reference also teaches feeding high saturation wet distiller's grain with solubles to eliminate acidosis in beef cattle, as well as for improving health and milk/meat quality of dairy cows and beef cattle.

US Patent 5,177,008 teaches a method of producing glycerol as a co-product
5 of ethanol fermentation.

Previously, distiller's grain has been fed to lactating dairy cattle, for example, in place of corn grain or soybean meal and was found to increase milk fat production (Al-Suwaiegh et al., 2002, J. Anim. Sci. 80: 1105-1111). It has also been reported that dried distillers grains are beneficial in some ruminant diets due to their high content of
10 undegraded intake protein (UIP) (Peter et al., 2000, J. Anim. Sci. 78: 1-6). It was proposed that replacing corn in the diet of finishing sheep and cattle with distillers byproducts may help control subacute acidosis on the basis that high starch intake leads to increased production of ruminal organic acids, which in turn may cause reductions in gain and efficiency (Lodge et al., 1997, J. Anim. Sci. 75: 44-50).
15 However, distiller's grain is known to be high in long-chain unsaturated fatty acids which, for example, increase the amounts of C_{18:0} and C_{18:1} in milk fat when fed to dairy cows (Schingoethe et al., 1999, J. Dairy Sci. 82: 574-580).

SUMMARY OF THE INVENTION

20 According to a first aspect of the invention, there is provided a method of treating, preventing or ameliorating a cardiovascular pathology in an animal comprising:

administering to the animal in need of such treatment a food supplement

including distiller's grain.

The distiller's grain may be dry distiller's grain or wet distiller's grain.

The animal may be a livestock animal.

The cardiovascular pathology may be selected from the group consisting of
5 arrhythmia, hypertension, hypertrophy, ischaemia and heart failure, for example,
myocardial infarction, ischemic infarction and congestive heart failure.

According to a further aspect of the invention, there is provided the use of an
effective amount of distiller's grain for treating ischaemia in an animal subjected to
ischemia wherein the distiller's grain is formulated as a food portion for said animal.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 – shows the daily water intake of rats fed normal chow (control, ▼),
and rats fed DDG (DDG, ○) (N=3). Data is shown in Table 1.

FIGURE 2 – shows the daily food intake of rats fed normal chow (control, ▼),
15 and rats fed DDG (DDG, ○) (N=3). Data is shown in Table 2.

FIGURE 3 – is a bar graph showing change in body weight of rats fed normal
chow (control, □), and rats fed DDG (DDG, ■) (N=3). *p 0.05 as compared to day zero
values of respective fed group. #p 0.05 as compared to control values at that time
point. Data was analysed using one-way analysis variance (ANOVA) followed by a
20 post-hoc Student Newman Keul's test.

FIGURE 4 is a bar graph showing blood glucose levels of rats fed normal chow
(control, □), and rats fed DDG (DDG, ■) (N=3). #p 0.05 as compared to control values
at that time point. Data was analysed using one-way analysis variance (ANOVA)

3a

followed by a post-hoc Student Newman Keul's test.

FIGURE 5 (A) shows the percent live adult rat ventricular myocytes (AVRM) without ischemia (control, ○; DDG, ●); (B) shows the effect of ischemia (mineral oil) on

ARVMs obtained from normal fed (normal chow, control, Δ) and DDG-fed (DDG, $\blacktriangle$) rats. * p 0.05 Vs. control (ischemia to ARVM obtained from normal fed rats) at corresponding time point. Data was analysed using one-way analysis variance (ANOVA) followed by a post-hoc Student Newman Keul's test.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and materials are now described.

Described herein is the use of distiller's grain, for example dry and/or wet distiller's grain, as a food supplement for a animal, for example, humans, livestock, poultry or fish, for example, although by no means limited to feeder cattle, feeder hogs, broiler chickens, turkeys and fish. As will be apparent to one of skill in the art, these animals are typically bred to be fast-growing or are fed supplements to encourage fast growth. This places considerable strain on the cardiovascular system of the developing animal or human, thereby putting the animal or human at risk of developing any one of a number of cardiovascular pathologies, for example, but by no means limited to arrhythmia, hypertension, hypertrophy, ischaemia and heart failure, as well as cardiovascular pathologies associated with diabetes. As discussed above, cardiac arrhythmia can lead to up to 30% of the livestock in a given feedlot dying prior

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to slaughter.

Dry distiller's grain has been used as a feed ingredient, typically 30-40% of feeder rations and about 20-30% of dairy rations. As discussed above, wet distillers grain has been shown to be superior to dry distiller's grain.

5 While distiller's grain has been proposed to be beneficial for animals for treating animals with acidosis or other liver ailments due to its low starch content, it has not previously been proposed that distiller's grain can promote cardiac development, thereby treating or ameliorating or preventing arrhythmia.

10 It is of note that the distiller's grain may also be fed to individuals or animals suffering from diabetes as a method of treating, ameliorating or preventing diabetes-related cardiovascular pathologies. It is of note that it may be Type I diabetes or Type II diabetes (Mahgoub and Abd-Elfattah, 1998, Mol Cell Biochem 180: 59-64).

15 While not wishing to be limited or bound to a specific hypothesis, the inventor notes that many cardiovascular pathologies such as arrhythmia are caused by oxidants or by increased calcium influx into the heart. As such, wet and/or dry distiller's grain may act as an anti-oxidant or may act as a calcium channel antagonist, thereby relieving stress on the cardiovascular system of the animal. In view of this, as will be appreciated by one of skill in the art, it is clear that wet and/or dry distiller's grain will be beneficial in a wide variety of animals.

20 Furthermore, as discussed below, adult rat ventricular myocytes from rats fed a diet of DDG had increased survival when subjected to ischemia using the mineral oil layering induced model of ischemia (Meldrum et al., 2001, Journal of Surgical Research 99: 288-293; Vander Heide et al., 1990, Mol Cell Cardiol 22: 165-181). As

noted by Vetterlein et al., 2003, Am J Physiol Heart Circ Physiol 285: H755-H765, even though an ischemic injury may appear reversible, a certain fraction of the myocytes may develop necrosis upon reperfusion. This is consistent with the view that ischemia, which refers to a lack of oxygen due to inadequate perfusion, causes
5 transient disturbances of the mechanical (reduced heart function and heart failure), structural (hypertrophy), biochemical (hypertension) and electrical functions (arrhythmia) of the myocardium. It is also worth noting that the damage upon reperfusion is dependent upon the extent of ischemia. This in turn can lead to other cardiac pathologies, as discussed above. Thus, preventing or protecting myocytes
10 from ischemia will protect the cardiovascular system of an animal from other cardiac pathologies as well.

Moreover, since diabetes is associated with the cardiovascular complications mentioned above, wet and/or dry distiller's grain would be beneficial if administered to individuals having or at risk of developing diabetes.

15 The wet and/or dry distiller's grain may be prepared from any suitable source, for example, wheat, cereal grains, barley and/or corn.

Dry distiller's grain typically has a moisture content of about 5-8%, protein content of about 25-40%, fibre content of about 7-10%, calcium content of about 0.10-0.15%, phosphorus content of about 0.7-0.95%, potassium content of about 0.4-1.1%
20 and about 250-400 ppm of iron.

In some embodiments, wet and/or dry distiller's grain is used as a food supplement, mixed with, for example, traditional livestock feed, at a ratio between 1 part distiller's grain: 9 parts feed to 3 parts distiller's grain: 1 part feed, inclusive.

Furthermore, for humans, wet and/or dry distiller's grain could be incorporated into bakery products, for example, bread, buns and the like, or into other suitable foods, for example, cereal, granola, breakfast or energy bars or the like. As will be appreciated by one of skill in the art, the process of making these food items is well known in the art and wet and/or dry DDG can easily be substituted for one or more of the traditional ingredients.

As discussed above, in some embodiments, wet and/or dry distiller's grain is mixed with a food supplement or food product and an effective dose thereof is administered to an animal at risk of or suffering from at least one cardiovascular pathology, thereby treating or ameliorating or preventing the cardiovascular pathology.

Arrhythmia is a dissociation between atrial and ventricular contractions which in turn raises atrial pressures. Hypertrophy occurs when ventricles respond to a chronically hemodynamic burden by developing an increase in muscle mass. Ischemia refers to a lack of oxygen due to inadequate perfusion which results from an imbalance between oxygen supply and demand. Heart failure is defined as an abnormality of cardiac function caused for example by a reduction in cardiac efficiency and/or alterations in energy metabolism which in turn results in a failure of the heart to pump blood at a rate commensurate with the requirements of the metabolizing tissues. Hypertension refers to increased or elevated arterial pressure. As discussed above, distiller's grain will treat, prevent or ameliorate symptoms associated with these and other cardiovascular pathologies by acting as an anti-oxidant and/or as a calcium channel antagonist, thereby removing stress on the heart

and cardiovascular system of the mammal.

Referring to the accompanying tables and figures, rats were fed a diet of normal chow (control) or DDG. As can be seen in Table 1 and Figure 1, initially, water intake by the DDG-fed rats was lower than that of the control rats, but increased to levels at or above that of the control rats within 3 days. Similarly, as can be seen in Table 2 and Figure 2, food intake of DDG-fed rats was initially lower than that of control rats but increased to levels at or above that observed for control rats within 3 days. As can be seen in Figure 3, the change in body weight of DDG-fed rats was noticeably lower than that of the control-fed rats after 7 days, slightly lower after 14 days and in fact slightly higher after 21 days. Referring to Figure 4, the blood glucose levels of DDG-fed rats were lower compared to the control-fed rats at days 0, 7 and 14. This suggests that DDG has the ability to decrease blood sugar, which in turn further supports the effectiveness of administering DDG as a treatment for diabetes.

Taken together, these data clearly indicate that feeding animals a diet of DDG had no longer term negative effects on water intake, food intake, or change in body weight.

However, as shown in Figure 5, DDG has the surprising effect of protecting adult rat ventricular myocytes from cell death due to ischemia. Specifically, as can be seen in Figure 5(B), incubation of ARVMs from control rats in mineral oil resulted in a marked decrease in cell survival, compared to a gradual decrease in survival over time as seen in Figure 5(A). However, ARVMs from rats fed DDG do not show a marked decrease in cell survival, but rather show a survival curve that is remarkably similar to that seen without mineral oil treatment (see Figure 5B vs Figure 5A).

While the preferred embodiments of the invention have been described above, it will be recognized and understood that various modifications may be made therein, and the appended claims are intended to cover all such modifications which may fall within the spirit and scope of the invention.

Table 1. Daily water intake (ml) in control (normal chow) and DDG fed rats (N=3)

	Day	Control	DDG
	1	53.33±1.66	26.66±1.66
	2	50±5	38.33±4.40
5	3	43.33±3.33	52.5±2.5
	4	46.66±1.66	53.33±3.33
	5	46.66±1.66	50±2.88
	6	50±0	56±2.081
	7	50±2.88	51.66±1.66
10	8	56.66±4.40	59.16±4.63
	9	51.66±4.40	55±2.88
	10	48.33±1.66	54.16±2.20
	11	48.33±3.33	60±0
	12	48.33±3.33	53.33±1.66
15	13	50±2.886	58.33±3.33
	14	50±2.88	53.33±1.66
	15	51.66±1.66	63.33±3.33
	16	55±2.886	55±2.88
	17	51.66±1.66	58.33±4.40
20	18	48.33±1.66	55±0
	19	55±2.88	56.66±3.33
	20	46.66±3.33	51.66±3.33
	21	55±0	58.33±0.83

Table 2. Daily food intake (gm/day) in control (normal chow fed) and DDG fed rats (N=3).

	Day	Control	DDG
5	1	24.61±0.36	9.08±4.23
	2	25.69±1.79	14.89±2.29
	3	23.76±0.84	22.91±0.87
	4	24.42±0.76	24.71±1.30
	5	24.52±1.21	24.17±2.20
10	6	24.61±1.44	23.35±0.86
	7	24.96±1.32	25.73±1.74
	8	23.08±2.36	25.49±1.66
	9	26.12±1.54	22.88±1.15
	10	23.08±1.49	25.82±1.28
15	11	24.57±0.35	24.75±1.59
	12	22.81±1.82	25.81±1.57
	13	23.58±1.80	24.51±0.51
	14	26.63±1.45	23.02±2.12
	15	23.21±0.97	27.76±0.85
20	16	26.37±0.69	23.79±1.42
	17	24.70±0.43	27.57±1.54
	18	23.71±0.40	25.40±1.43
	19	28.33±1.87	26.63±1.56
	20	22.93±1.69	25.22±1.12
25	21	26.81±2.23	25.59±1.15

CLAIMS

1. Use of an effective amount of distiller's grain for treating ischaemia in an animal subjected to ischemia wherein the distiller's grain is formulated as a food portion for said animal.
- 5 2. The use according to claim 1 wherein the distiller's grain is dry distiller's grain.
3. The use according to claim 1 wherein the distiller's grain is wet distiller's grain.
4. The use according to claim 1 wherein the animal is a livestock animal
10 grown for meat.
5. The use according to claim 1 wherein the food portion is a bakery product.
6. The use according to claim 1 wherein the food portion is a cereal product.
- 15 7. The use according to claim 1 wherein the food portion is a breakfast or energy bar.
8. The use according to claim 1 wherein the animal is a human.
9. The use according to claim 5 wherein the animal is a human.

Daily water intake

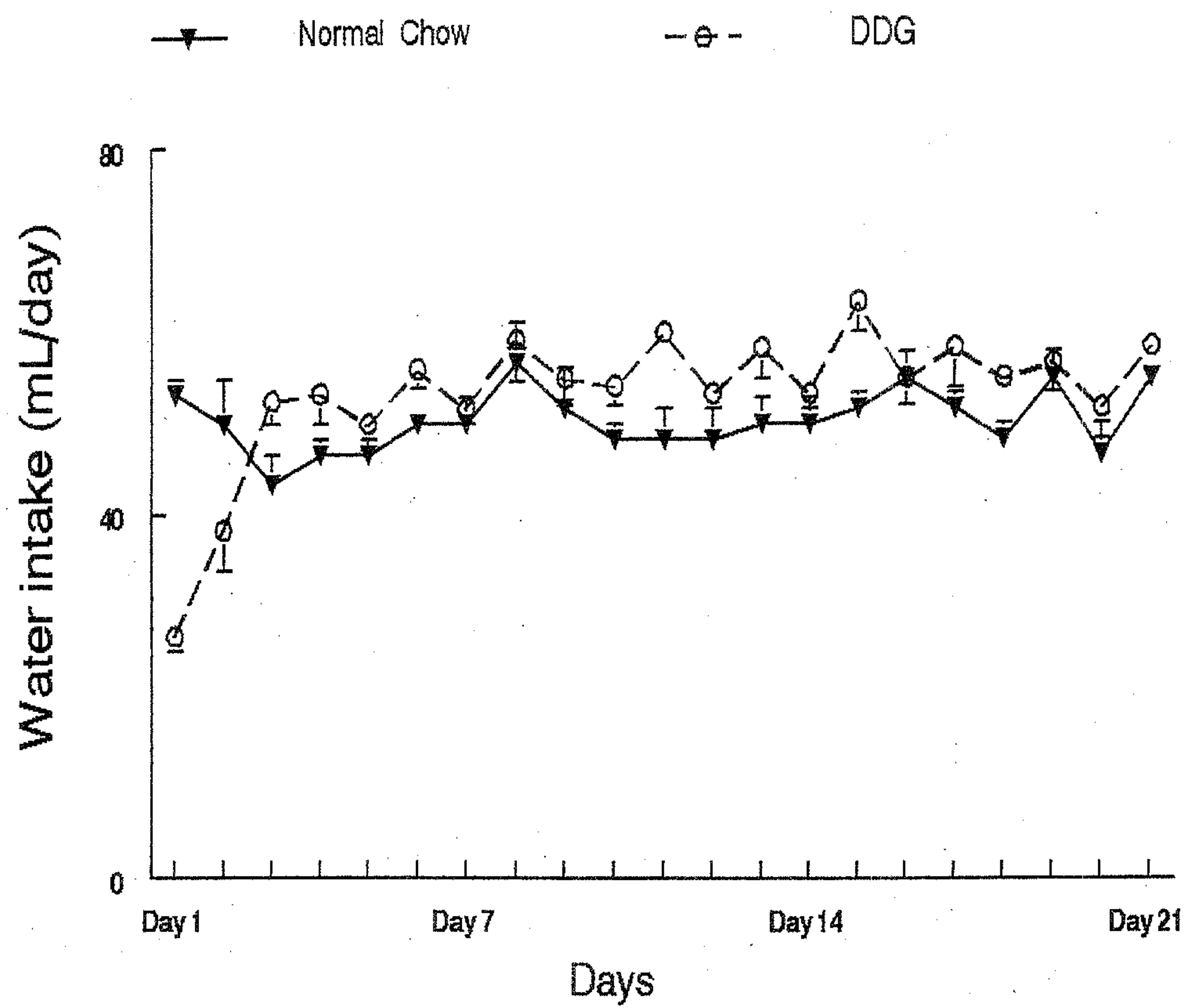


Figure 1:

Daily food intake

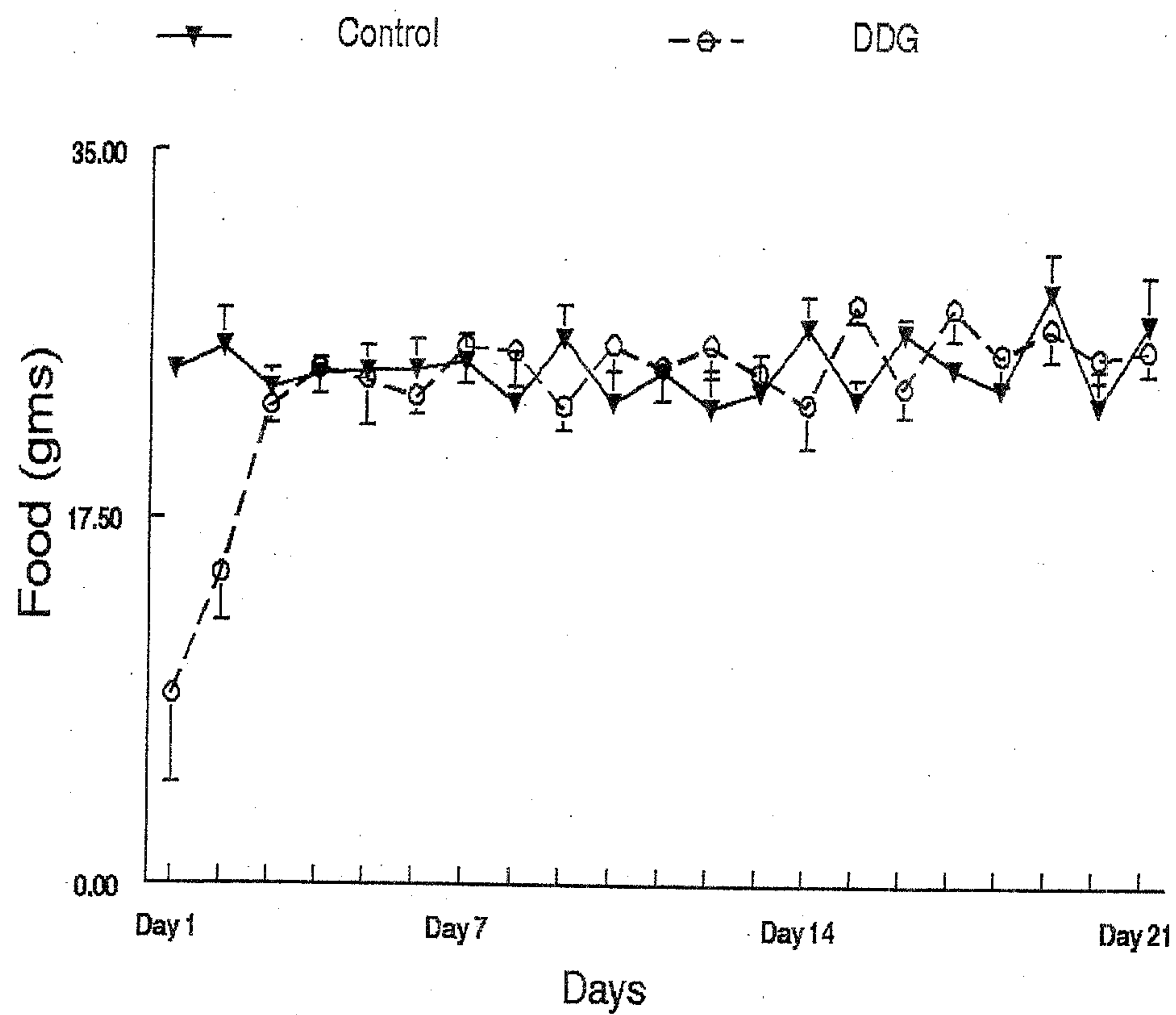
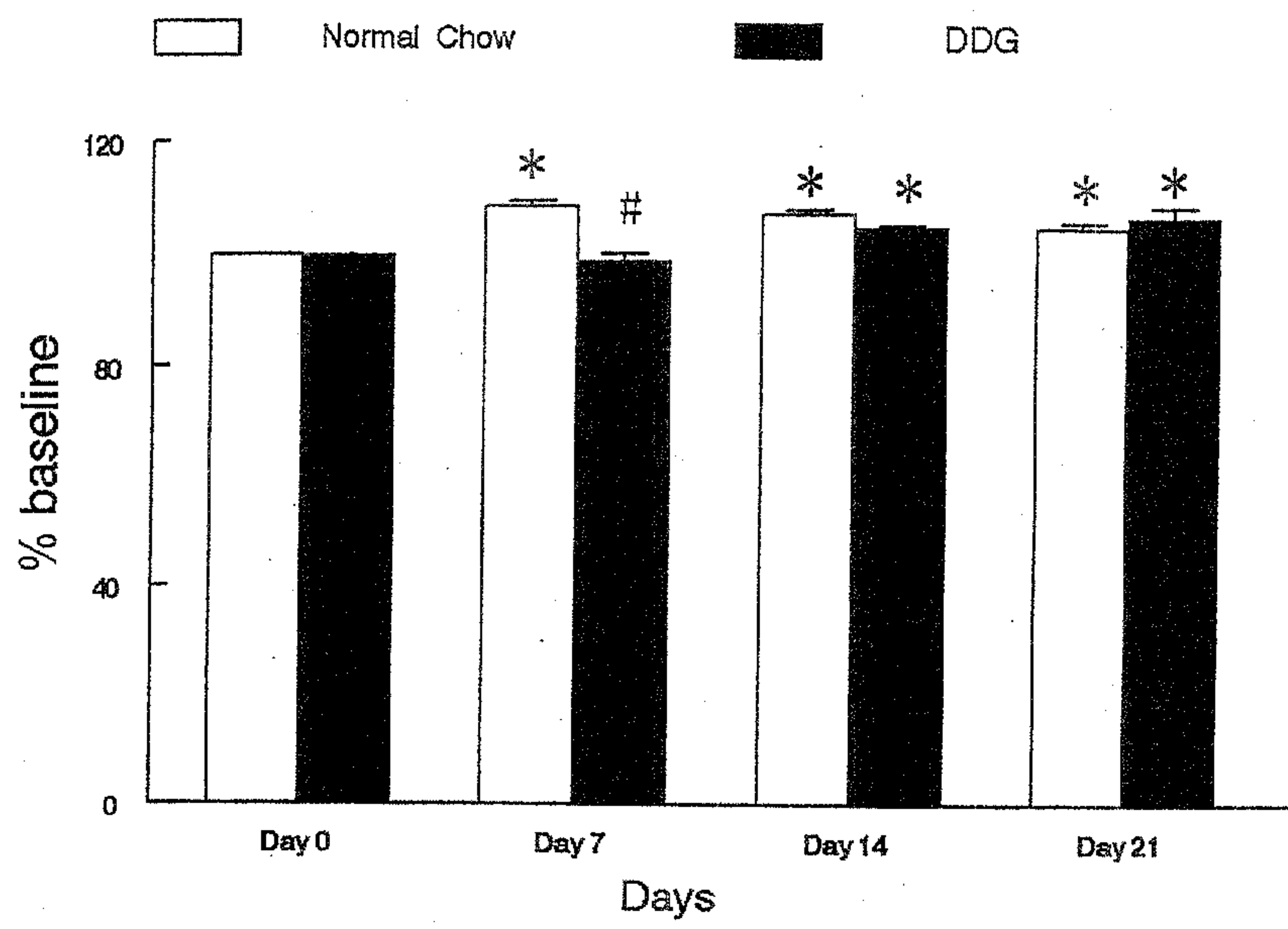
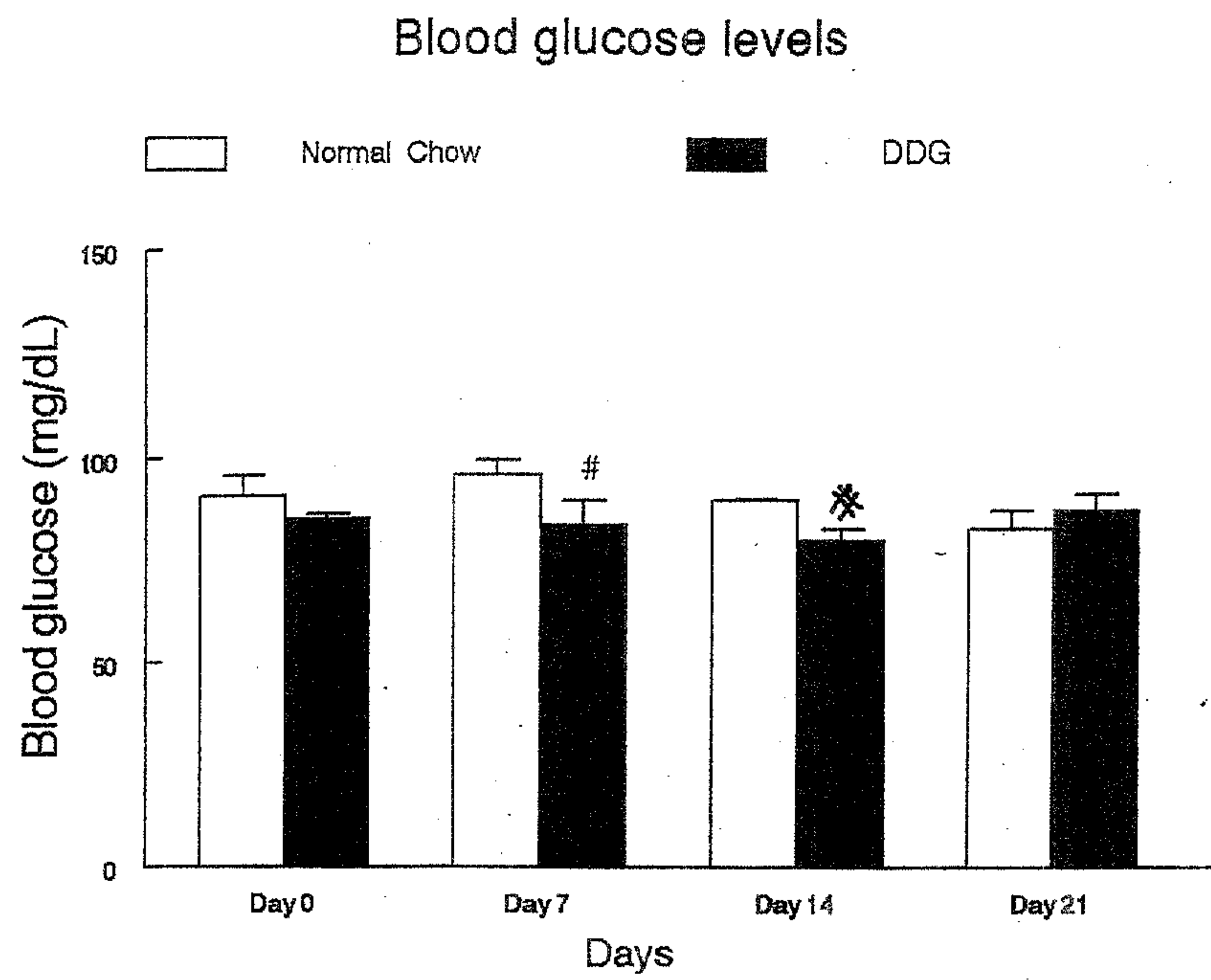


Figure 2:

**Figure 3:**

**Figure 4:**

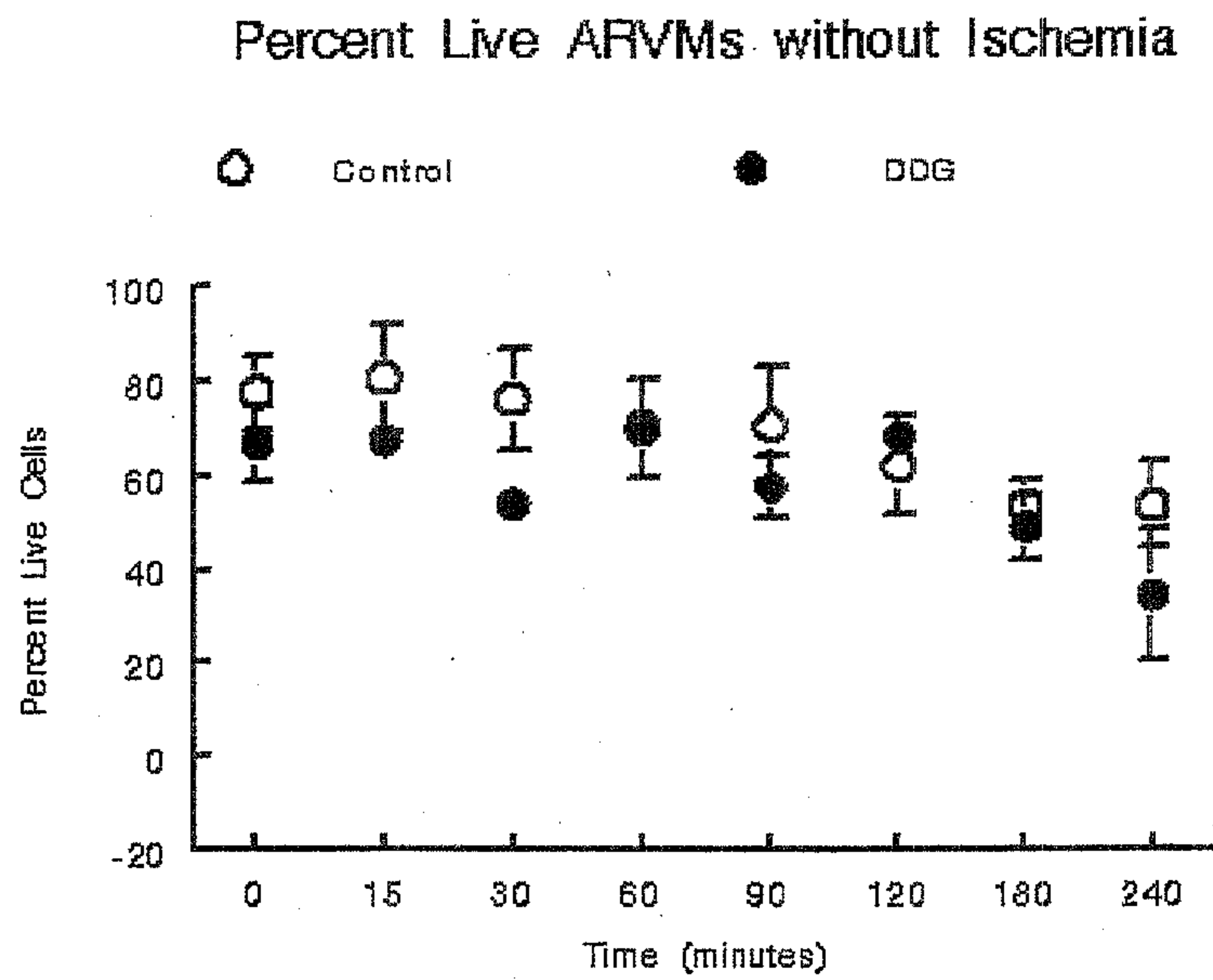
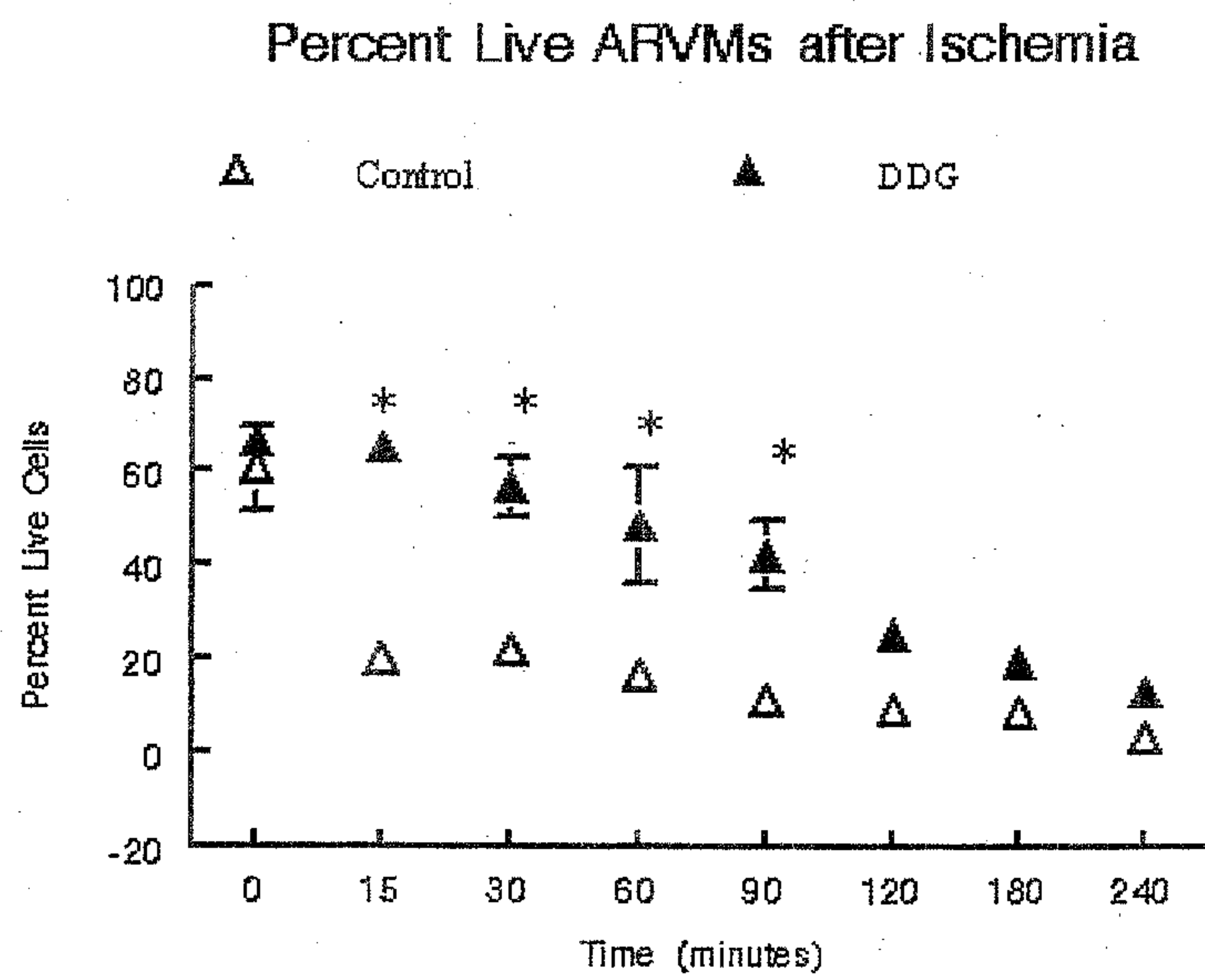
A**B**

Figure 5: