STUDY THE NUTRITIONAL PROPERTIES OF SOME INFANT FORMULA AVAILABLE IN KUFA AND NAJAF LOCAL MARKETS

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ABSTRACT:

This study was conducted to evaluated nutritional properties of some infant formulas available in the local markets and their effects on the growth and nutritional status of rats and their body organs. This experiment was designed using 42 white male rats (Albino) with initial average weight of 50±5 g, they were divided into 7 groups of 6 rats per group. The experiment continuous for 28 days during which the rats were fed on infant milk formula treatments T_1, T_2 and T_3 to age less than 6 month (Nactalia1, Dielac1 and Evolac1) respectively, and in treatments T_4, T_5,T_6 feed on infant milk formula for age more than 6 month (Celia2, Dielac2 and Sunny baby2) respectively, and the rest of rats in control treatment fed on standard provender and filter water. The results showed significant ($P \leq 0.05$) decrease in final weight rate of rats in T_3 which was 118.7 g recording the lowest weight gained 72.8 g during the experiment period, while treatment T_5 recorded the highest weight increase gained reaching 118.4 g and final weight rate (169.8 g). In control treatment was significantly ($P \leq 0.05$) higher in amount food intake compared to all other treatments, while treatments T_2 and T_3 have the higher and lower amount of food intake respectively.. On the other hand, it was noted decrease in relative weight of rats' kidneys in treatment T_1, T_2 and T_3 compare with the control treatment, which recorded the highest average of relative weight for rats' kidneys of 1.086 g.

Keyword: Infant formula, Nutritional properties, rats, Food efficiency.

دراسة الخصائص التغذوية لبعض خلائط حليب الأطفال المتوفرة في الأسواق المحلية لمدينتي الكوفة والنجف الاشرف

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المستخلص:

أجريت هذه الدراسة لتقييم الخواص التغذوية لبعض خلائط حليب الأطفال المتوفرة في الأسواق المحلية ومعرفة تأثيرها على نمو الجرذان وحالتها التغذوية واعضاءها الداخلية. حيث صممت التجربة باستعمال 42 حيوان من ذكور جرذان Albino البيضاء بمعدل وزن ابتدائي 50±5غم. وقسمت الى سبع مجاميع بواقع 6

[1] **البحث مستل من رسالة ماجستير للباحث الأول**

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جرذان لكل مجموعة. واستمرت التجربة لمدة 28 يوم تم خلالها تغذية الجرذان في المعاملات T1، T2وT3على خلائط حليب الأطفال لعمر اقل من 6 أشهر (Nactalia1،Dielac1 وEvolac1) وفي المعاملات T4، T5وT6 على خلائط حليب الأطفال لعمر فوق 6 أشهر (Celia2،Dielac2 وSunnybaby2) على التوالي. وإبقاء تغذية جرذان معاملة السيطرة على العليقة القياسية والماء المفلتر. أظهرت النتائج انخفاض معنوي في معدل الوزن النهائي لجرذان المعاملة T3 اذ كانت 118.7 غم والتي سجلت أدنى زيادة وزنية مكتسبة خلال فترة التجربة حيث بلغت 72.8 غم. بينما سجلت المعاملة T5 اعلى معدل للزيادة الوزنية المكتسبة حيث بلغت 118.4 غم وبمعدل وزن نهائي 169.8 غم. كما لوحظ تفوق معاملة السيطرة معنويا من حيث كمية الغذاء المتناول على جميع المعاملات عند مستوى احتمال($p\leq0.05$). وكانت اعلى وأدنى كمية غذاء متناول في المعاملتين T2وT3على التوالي. من جهة أخرى لوحظ انخفاض في الوزن النسبي لكلى الجرذان في المعاملات T1، T2وT3 مقارنة مع معاملة السيطرة التي سجلت أعلى معدل لوزن الكلى النسبي حيث بلغ 1.086 غم.

الكلمات المفتاحية: حليب الأطفال ، جرذان ، كفاءة الغذاء ، الخواص التغذوية

INTRODUCTION

Milk is one of the most important components of the human diet in many parts of the world and the average per capita consumption is of 180 in Iceland and Finland to less than 50 in Japan and China [1]. Milk contains all the nutrients necessary for the physiological functions of the body as well as containing fat, proteins, enzymes and bioactive peptides. It is the most natural foods beneficial to humans in all stages of life [2]. Dried powder cow's milk is one of the most widely used for alternative feeding in the world, accounting for the largest share of global production. It accounted for 83% of global milk production in 2010 [3]. Infant Formulas are used as an alternative to mother's milk (breast milk) to equip infants with nutritional needs either as a supplement to Mother's milk or individually when breastfeeding is not possible [4]. More than 80% of American children feed on infants formulas for some time during the first 12 months of their lives [5].

Most of infant formulas types are mainly made of cow milk with some modifications to substitute breast milk by adding protein in the form of basic amino acids and adjust fat and add unsaturated fatty acids, vegetable oils and some sugars are supported by some vitamins, minerals and nucleotides[6]. Infant formula must contain appropriate amounts of water, carbohydrates and protein, fats, vitamins, and minerals and regulate their composition with high rudder. Each plant must follow the guidelines established by the government authorities. For example, all major ingredients added to milk mixtures (protein, fat, carbohydrates) have minimum and maximum values to be active and these ingredients must have a safe use date [7]. Support milk mixtures only children's health and does not cause them unusual food or medical problems. Therefore, the regulation and control of the manufacturing process with high degree of accuracy to meet national and international quality standards [8, 9].

Since Iraq depends on imports to meet its need of milk and mixtures of various companies, local markets have become replete with various kinds of infant formulas from many different origins of the world. This makes proper selection of the right formula is difficult. The careful selection of any infant formula must depend on the formula's components compared to other available formulas. The lack of such information is a pressing gap that

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need to be fulfilled. Thus the aim of this study was to identify the nutritional properties of some infant formulas available in local markets and whether or not they meet our young infants and children needs in terms of nutrients and growth requirements.

MATERIALS AND METHODS

Sampling: A comprehensive survey of the types of infant formula available in pharmacies and local markets has been conducted in the cities of Kufa and Najaf, three models of some infant formula were selected (Nactalia1,Dielac1 and Evolac1) for the First age of 6 months of birth and anther three formulas (Celia2, Dielac2 and Sunnybaby2) for the second stage infant age of 6 – 12 month

EXPERIMENT ANIMALS

The experiment was conducted under laboratory conditions at the Animal House belongs to the College of Veterinary Medicine/ University of Kufa useing 42 white male rats (Albino) obtained from College of Veterinary Medicine.

The initial weight of rats were 50 ±5 g and they were placed under controlled conditions in terms of ventilation and temperatures that ranged from 25 C˚ to 27 C˚ and lighting period of 12 hours per day. The animals were maintained in plastic cages, the cage floor was daily cleaned, sterilized and brushed with sawdust.

The animals were left for three days before starting the experiment for adapting to the new environment. The rats were randomly distributed to 7 groups with 6 rats per group, each rat was marked with different stain color for recognizing within the same group. After 3 days of adaptation, rats were treated daily for 28 days and treatments were as follows:

1- **C** control group : The rats were fed on standard provender (Casein 20, Sucrose10, Cellulose5, Corn starch 53, Choline0.2, Mineral mixture3.5 and Vitamin mixture1, Corn oil 7)g/100g and filtered water [10].
2- **T1** Treatment group: The rats were fed on Nactalia1 for 4 weeks.
3- **T2** Treatment group: The rats were fed on Deilac1 for 4 weeks.
4- **T3** Treatment group: The rats were fed on Evolac1 for 4 weeks.
5- **T4** Treatment group: The rats were fed on Celia 2 for 4 weeks.
6- **T5** Treatment group: The rats were fed on Deilac2 for 4 weeks.
7- **T6** Treatment group: The rats were fed on Sunny baby2 for 4 weeks.

Monitoring, measuring and recording

The daily biotic activities of the experimental animals were monitored for the purpose of registering any notes and abnormal situations in the animals' movement or behavior. Animals have also been observed in case of change of eyes color, tail and hair of animals as well as recording if any case of diarrhea or any other unusual health issues.

Each animal weight was measured using a one-arm scale twice a week for further increases or decreases in body weight and the following indicators were calculated by the method used by previous study [11]

1. The amount of food consumed throughout the experiment period = total amount of food- remaining amount of food
2. Weight gain = final body weight - initial body weight

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3. Food efficiency rate = weight gain /amount of consumed food

The relative weight of the liver and kidneys:

At the end of the experiment rats feed was cut off for about 12 hours (overnight fasting) after that rats were anesthetized by muscle injection using my ketamine and Xylazine [12], Then the front and rear limbs were firmly fixed by pins and dissected posteriorly using a sharp pair of scissors and the liver and kidneys were cut off and washed in physiological solution of sodium chloride 0.9%, dried up between two towel papers with hand pressing, and the relative weight of liver and kidneys was calculated according to[13] using the equation where the relative weight of the liver = weight of the liver/weight of body *100 and the relative weight of the kidneys= weight of the kidneys/ weight of body *100.

THE STATISTICAL ANALYSIS

The experimental data were subjected to Analysis of Variance (ANOVA) using GenStat package 2009, (12th edition) version 12.1.0.3278 [14] Statistical analysis was carried out for the experiment, which was Completely Randomized Design (CRD). Means were compared for differences and Duncan's Multiple Range test was used whenever appropriate at 95% of confidence ($P \leq 0.05$) [15].

RESULTS AND DISCUSSION

Effect of treatment with milk mixtures on weights of experimental animals:

Results of the statistical analysis shown in table (1) that there was no differences among the experimental animals in terms of initial average weight ($P \leq 0.05$), while there was significant difference among averages of final weight. The lowest final weight in treatment T3 which was 118.7g compared with the control treatment C that of 151.9 g. However, T3 did not differ from the first ages formulas (T2, T1) with final average weight were 137.3 and 129.2g, respectively.

Whereas the T5 treatment had the highest body weight average at the end of experiment which was 169.8g with significant differences ($P \leq 0.05$) from the first stage formulas, but not with the control (151.9 g), T4 (153.7 g) and T6 (148.5 g). All tested formulas including the control caused increase in the body weight. This mostly is due to their rich contents of essential nutrients, vitamins and minerals especially proteins that contribute in the construction of cells and body organs [16].

Weight gain after 28 days as in table (1) showed significant differences where the average of body weight increased ($P \leq 0.05$), the highest increase in weight gain was in T_5 (118.4 g), while the lowest increase in weight gain was in T_3 (72.8 g). In the first stage formulas, T_2 had the highest increase of weight gain with 86.3 g, which did not differed from the rest of the group members but at the same time weight gain of this group was less than that of the control (100.7 g). The total increase of weight gain in the second stage formulas also did not differed ($P \leq 0.05$) from that yielded from the control. Rise in the overweight rates of rat groups by second-stage milk mixtures was not of a moral value

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compared to control treatment C at the same level of probability.

The variation in the rates of weight gained among treatments may be due to the variation in protein ratios that differed as infant formula differs. Dielac2 milk has higher protein content ratio and this resulted in higher rate of weight gain, and this is agreeing with Al-Jabari [17] study in which the weight gain was attributed to the type of infant formulas and their protein content.

Table 1. Primary (initial) and final weight and average of daily increase in body weight gained in 28 days experiment.

Measured qualities / Groups	The primary weight (g)	The weight after 28 days(g)	Weight Gain after 28 days (g)	daily increase in body weight(g/day)
C standard provender +filtered water	51.3 a	151.9 bc	100.7 bc	3.597 bc
T_1 Nactalia 1	54.6 a	129.2 ab	74.6 a	2.664 a
T_2 Dielac 1	51.0 a	137.3 ab	86.3 ab	3.081 ab
T_3 Evolac 1	45.9 a	118.7 a	72.8 a	2.599 a
T_4 Celia 2	48.4 a	153.7 bc	105.3 bc	3.762 bc
T_5 Dielac 2	51.4 a	169.8 c	118.4 c	4.229 c
T_6 Sunny baby 2	47.5 a	148.5 bc	101.0 bc	3.607 bc

-data are average of 6 replications (6 rats per group)
-Means followed by different letter within column indicate significant difference ($P \leq 0.05$)

Table (1) also showed differences among treatments in daily increase of body weight. T_5 was 4.229 g/day and significantly, ($P \leq 0.05$) differed from all first stage formulas (T_1, T_2 and T_3) which were 2.664, 3.081 and 2.599 g/day, respectively. T5, however, did not differed from all other treatments in the daily weight gain.

Weekly increase gained in weight of male rats

Figure (1) illustrates weekly increase gained in body weight of male rats during 4 weeks of treatments. It can be observed that weight gain during the first week in all treatments was dropped down with values less than that gained

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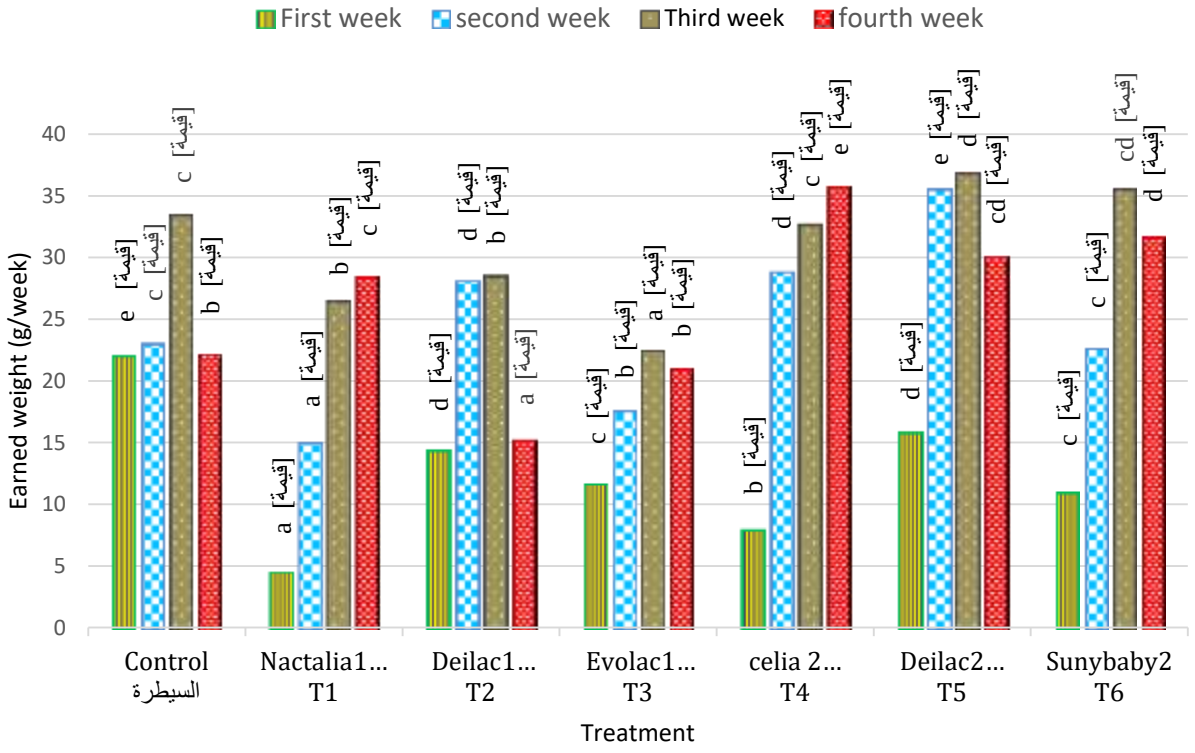
from the control. This may be due to the sudden shift in food supplement where the feed was changed from standard provender to infant milk formulas in the liquid form. The liquid milk caused diarrhea symptoms to all rats decreasing the growth and body weight gain of all treatments except the control rats which were fed of the standard provender.

In the second week, the growth and weight gain for all treatments was enhanced. T_2 had highest weight gain (28.13g/week) among the first stage treatments. While, T5 had the highest body weight gain (35.6 g/week) compared to the second stage treatments. The body weight gain was continuous throughout the third week. T2 again had the highest weight gain (28.54 g/week) among the first stage formulas but was less than the weight gain of the control (33.44 g/week). However, two of the second stage formulas T5 (36.85 g/week) and T6 (35.59 g/week) resulted in higher, but not significant, weight gain compared to the control.



Means followed by different letter within column indicate significant difference ($P \leq 0.05$)

Figure 1. Effect of treatment of infant formula on the weekly increase in the weight of male rats

During fourth week, clearly decrease in weight gain for treatments C, T_2,T_5 and T_6 which were 22.19, 15.27, 30.1 and 31.67 g/week, respectively, with a slight weight gain decrease in treatment T_3 that of 21.01g/week compared to values of the previous week. While continues weight gain was observed in

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treatments T4 (35.75 g/week) and T1 (28.49 g/week) compared with The previous week.

This decrease in weight gain may be related to damage of kidney tissue due to high protein ratio in second-stage milk formulas especially in Dielac2 and the control treatment (C). Al-Salihi [18] proposed that there was bleeding and congestion and kidney inflation caused by high protein in dietary supplements used to treat white rabbit males. It also reported by Fleddermann *et. al*., [19] that using less protein in infant milk formulas and fortified with high nutritional protein (α-Lactalbumin) will significantly reduce the overall functional load on infant's kidney.

Food intake, food efficiency rate and relative weight of internal organs

Table (2) illustrated the amount of food intake calculated on the basis of dry weight and food efficiency rate and relative weight of internal organs(liver and kidney) for rats treated by the infant formulas under this study .

There was significant differences in the amount of food intake at a level of probability ($P \leq 0.05$). Rats group T_1, T_2 have highest values in term of amount of food intake, which reached 341.5 g and 337.5 g, respectively, and they were significantly different from the rest of all other treatments except the control in which the amount of food intake was 384.4g. T_3, on the other hand, had significantly the lowest amount of food intake (251.00 g). This may be related to continuous cases of diarrhea in treated animals with this type of infant formula, resulting in anorexia or due to excessive fortification with vitamins and minerals. Al-Talib and Manki [6] stated that most infant formulas are supported by high proportions of vitamins and mineral more than recommended daily intake, especially vitamin A which causes a decrease in rat appetite and consequent weight loss [20].

Dewey *et. al*., [21] noted that having high amounts of iron by children between the ages of 4 and 9 months who have sufficient iron intake can lead to negative impact on the incidence of diarrhea. In the same way another studies [22,23] referred to that intake of supported infant formula with high amounts of iron by infants with sufficient quantities may adversely affect growth, development and perception.

From table (2) there is significant difference in food efficiency rate among different treatments ($p \leq 0.05$). Highest food efficiency rate were in treatments T_4 (0.34 g),T_5 (0.37 g) and T_6 (0.36 g). This may be due to the high protein content relative to the amount of energy provided by infant formulas Celia2, Dielac2 and Sunny baby2. While treatment T_1 was (0.21 g) the lowest in food efficiency rate with the lowest protein per 100 kilos of energy. Food efficiency rate in treatments T2 and T_3 were (0.26 and 0.29 g) respectively, and they did not differ from the control (0.26 g) food efficiency rate.

Also table (2) illustrated absence of significant differences in relative weight of rats' liver treated with the studied infant formulas ($p \leq 0.05$). While observing the decrease of relative weight of rats' kidneys in treatments T_1, T_2 and T_3 (first stage formulas) resulting in 0.878, 0.898 and 0.894 %, respectively, compared to that from the control treatment (1.086%).

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The relative weight of rats' kidneys was much higher in treatment T4 (0.924%), T_5 (0.964%) and T_6 (0.955%) (Second stage formulas), but with no significant difference from the control treatment. The height of the relative weights of the kidneys related to high protein ratio in standard provender used in the control treatment and also in second stage formulas. This caused inflation, congestion and bleeding in the kidney tissue due to unwanted byproducts of the protein metabolism. And this agrees with Al-Jabari [10] explaining that the infant milk formulas containing higher protein ratio than recommended rate by the World Health Organization, Dielac (e.g.) milk group caused damage to the overall kidneys tissue, causing varying degrees of congestion and bleeding in the renal tissue, while the appropriate protein content (in Nactalia) did not cause any damage to the kidney tissue where the kidney tissue had normal appearance during the microscopic examination.

Table 2. The amount of Food intake and the rate of food efficiency and relative weight of liver and kidneys

Measured qualities / Groups	amount of food intake (g)	food efficiency rate (g)	relative weight of liver %	relative weight of kidney%
C standard provender +filtered water	384.4 e	0.26 ab	4.768 a	1.086 b
T_1 Nactalia 1	341.5 d	0.21 a	4.101 a	0.878 a
T2 Dielac 1	337.5 d	0.26 ab	4.769 a	0.898 a
T3 Evolac 1	251.0 a	0.29 b	4.839 a	0.849 a
T4 Celia 2	277.2 b	0.34 c	4.884 a	0.924 ab
T5 Dielac 2	320.5 c	0.37 c	4.605 a	0.964 ab
T6 Sunny baby 2	276.2 b	0.36 c	4.519 a	0.955 Ab

-data are average of 6 replications (6 rats per group)

-Means followed by different letter within column indicate significant difference ($P \leq 0.05$)

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