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The potential effect of some dairy products on liver functions, immunity and intestinal microbiota in rats

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The aim of this study was to compare the potential effect of rat consumption of different dairy products such as buffalo colostrum (BC), full fat yoghurt (FFY), fermented milk (FM), fermented milk supplemented with probiotics (FMSP), and whole milk (WM) on different parameters; immunological, histological, bacteriological and biochemical in an animal model. Rats were fed at 10% of different dairy products in their diets. The rats which were fed on buffalo colostrum diets showed higher levels of serum immunoglobulin, an improvement of liver functions, and histology of colon and liver tissues and lower percentage of body weight gain compared with other diet groups. Meanwhile the fermented milk diet showed the least improvement compared to the control group.

Key words: colostrum, dairy products, rats, histology, liver functions, immunology, intestinal microflora

INTRODUCTION

Mediterranean diets, fermented milk, and probiotics are assumed to have a favorable effect on intestinal microflora and human health. The high incidence of chronic diseases such as cancer, atherosclerosis, rheumatoid arthritis, and irritable bowel syndrome is of a major concern to health professionals and the governments (Vinderola et al. 2006).

The increasing interests in a healthy diet is stimulating innovative developments of scientific products in the food industry. The viable lactic acid bacteria in fermented milk products, such as yoghurt, have been associated with an increased lactose tolerance, well-balanced intestinal microflora, antimicrobial activity, stimulation of the immune system and antitumoural, anti-cholesterolemic and antioxidative properties in human subjects (Kullisaar et al. 2003)

Colostrum is the pre-milk fluid produced from the mother's mammary glands-it is a thick, yellow, milky substance secreted during the first few days after giving birth. Colostrum is a rich source of antibodies and is made up primarily of whey protein (75%) and casein. Growth factors and other important protein peptides make up the rest (Buckley et al. 1999).

Modern life style implies a reduced intake of beneficial bacteria; specifically in Western diets. In Egyptian diets, the situation could be far from previous in terms of quality of meals, dairy products (fermented milk) consumption, whole grain, legumes, fruits and vegetable contents. Long-term consumption of live yoghurt and fermented milk reduces nasal allergies, particularly in young adults. Studies in the growing pig, an accepted model for studying protein digestion in humans, show that nitrogen absorption from live yogurt is high. There are many additional health benefits of live yoghurt and fermented milk include alleviation of diarrhea and impact on gut flora. Additional health benefits of yogurt include the release of bioactive peptides (Levri et al. 2005).

Probiotics contain microbial cells which transit to the gastrointestinal tract and which, in doing so, benefit the health of the consumer. Lactobacilli are commonly used as probiotic bacteria, in recent years researchers and manufacturers are interested in development and marketing of preparations of living microbial cells (Isolauri et al. 1990). The activation of the systemic and secretory immune response by Lactobacilli requires many complex interactions among the different constituents of the intestinal ecosystem (microflora, epithelial cells and immune cells). Through different mechanisms they send signals to activate immune cells (Steer et al. 2000; Kruse et al. 1999).

The large bowel of humans is colonized by a complex microbial community that is often referred to as the intestinal microflora. This community includes possibly hundreds of bacterial species, although it is thought that 30 to 40 species account for 99% of the cells in the community (Debruyne et al. 2001). The collection of bacteria detected in feces reflects the bacteria present in the distal large bowel, so studies of the human intestinal microflora usually involve analyses of the bacterial community in fecal samples (Miller et al. 2000).

Although these studies have contributed significantly to our understanding of the human intestinal microflora, and immune system but we noticed the lacking of a comprehensive understanding of the effect of commercial dairy products on microbial feces composition, tissues, immune response and liver functions in an animal model.

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MATERIALS AND METHODS

Rats and Diets

Colostrum was milked within 6 hours after buffaloing from 3 buffalos of commercial farms in Manshiat el Bakaary region, Egypt. Full fat yoghourt (FFY), fermented milk (FM), fermented milk supplemented with probiotics (FMSP) and whole milk (WM) were purchased from local Egyptian markets and analysed for essential nutrients before mixing with the basal diet Ain-93M diet formulated for maintenance of adult rodents (Reeves et al. 1993). Bacteriological studies were conducted to investigate the microbiological status of all dairy products mixed with diets.

Table 1. Basal diet, Ain-93M

Ingredient	g/kg Diet
Cornstarch	465.692
Casein	140.000
Dextrinized corn starch	155.000
Sucrose	100.000
*Corn oil	40.000
Fiber	50.000
Mineral mix	35.000
Vitamin mix	10.000
L-cytesine	1.800
Cholin bitartarate	2.500
Tert-butylhydroquinone	0.008

*Soybean oil was replaced by corn oil

Experimental Animals

This study was performed on (n = 36) male at 8 weeks of age, the rats were housed and bred as approved by the Animal Ethics of Ophthalmology Institute Research; Egypt. The animals were kept on rodent chow for a week. After this washout period, rats were divided into 6 groups of 6 rats in each group. Rats were kept separately in metal cages in a room with controlled temperature (20 to 22°C) and humidity (50 to 55%), and maintained in a cycle of light for 12 h (06:00 to 18:00 h) and dark for 12 h (18:00 to 06:00 h). Albino Wistar male rats weighed between 115 and 135 g at the beginning of the experiment.

Experimental Design

All dairy products were mixed in a percentage of 10 % to each basal diet used, Table 1. Rats were divided into six groups as follows I: control group, rats of this group fed on basal diet only Table 1. Group II: buffalo colostrums group (BC), rats of this group fed on fresh buffalo colostrums mixed with basal diet. Group III: fermented milk supplemented with probiotics (FMSP) mixed with basal diet group. Group IV: fermented milk (FM) diet group rats were fed on basal diet mixed fermented milk. Group V: full fat yoghurt (FFY) diet group, the rats of this group were fed on basal diet mixed with full fat yoghurt. Group VI: The rats in this group were fed on of whole milk (WM) mixed with basal diet. Animals of the entire group fed for 30 day on the diets prescribed. Rats were allowed to consume their respective diets and water *ad libitum*, body weight and feed intake were recorded weekly.

Immuolological and Biochemical Studies

At the end of the week 4 of the feeding trial, rats were fasted overnight, and killed by carbon dioxide inhalation. Blood samples were collected immediately in sterile tubes from the retro orbital venous plexus, and left to stand for 30 min at room temperature (~20°C) to coagulate before being centrifuged for 20 min at 2000 rpm (Sorvall RT7, Newtown, MA). A number of immunological tests had been used after sacrificing rats such as humoral immune response at the levels of immunoglobulin classes; serum IgA, IgG & IgM by enzyme linked immune sorbent assay (ELISA). In brief, IgM, IgG and IgA were quantitated, follows ELISA protocol (Code No. 17194 IBL Co.Ltd, Japan). ELISA quantitation Kit, Catalog No. E110-100, E110-128, and E110-102 respectively, (Bethyl laboratories Inc., Japan). Solutions and reagents, step by step method and calculation of results were treated as manufacturer recommendations.

Rat Igs quantitative ELISA protocol

A. Solutions and Reagents

Buffers were prepared from the ELISA starter accessory kit buffer, coating buffer (0.05M carbonate-bicarbonate, pH 9.6) in addition to several solutions such as washing solution, blocking solution, sample/conjugate diluent, enzyme substrate and finally stopping solution.

B. Step- by-Step method (perform all steps at room temperature)

B1. Coating with capture antibody

In brief, one microliter of capture antibody solution was diluted to100µL coating buffer for each well to be coated. Incubation for 60 minutes and then aspiration, and washing each well as the manufacturer recommendations.

B2. Blocking solution

A 200 µL of blocking solution was added to each well, following that incubation for 30 minutes then remove the blocking solution and washing each well.

B3. Standards and samples

Standards and samples were prepared according to manufacturer instructions.

B4. A horseradish peroxidase enzyme (HRP) Detection antibody

HRP conjugate was diluted in conjugate diluent with the recommendation of the manufactures until incubation step for 60 minutes and removing HRP conjugate and washing each well 5 times.

B5. Enzyme substrate reaction

This step was performed by preparing solution tetra methyl benzidine (TMB) from ELISA starter accessory kit and mixed with the volumes of two-substrate reagents following the manufacturer instructions until measuring at 450nm.

C. Calculation of results

Average readings from each standard, control and sample were calculated and then subtracting the zero reading from each averaged value above to create a calibration curve for each set of samples

Tumor necrosis factor alpha (TNFα), was determined by using kit solid phase sandwich ELISA (IBL code no 17194, Japan) by using 2 kinds of high specific antibodies; tetra methyl benzidine (TMB) is used as coloring agent (chromogen). The strength of coloring is in proportion to the quantities of rat TNFα. The measuring range was 0.39~25 ng/mL. The method was summarized in Table 2.

Table 2. Determination of serum tumor necrosis factor alpha (TNFα) in rats

Reagents	Test sample	Standard	Test sample blank	Reagent blank
	Test sample 100 µL	Diluted standard (tube 1~7) 100 µL	EIA buffer (tube-8) 100 µL	EIA buffer 100 µL
Incubation for 1 hour at 37˚C with plate lid				
Washing 7 times				
Labeled antibody	100 µL	100 µL	100 µL	---
Incubation for 30 minutes at 4˚C with plate lid				
Washing 9 times				
TMB Buffer	100 µL	100 µL	100 µL	100 µL
Incubation for 30 minutes at room temperature (shielded)				
Stop solution	100 µL	100 µL	100 µL	100 µL
Reading the plate at 450 nm within 30 minutes after application of stop solution				

Moreover, the serum samples were analyzed for serum concentrations of Na^+ and K^+. In brief, deproteinization of serum was carried out on-line using a polyethylene powder cartridge as pre-column. The serum sample, after dilution, was injected into the chromatograph, and when passing through the cartridge the proteins were adsorbed by the polyethylene. A protein-free eluate was carried to the analytical column while the pre-column was washed with methanol and water to elute the adsorbed proteins by changing the pump channels. After washing, the pre-column was conditioned with the eluent to receive the next sample. Sodium, and potassium, determinations were performed by high-performance liquid chromatography with conductimetric detection (Bohrer 2000).

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined by IFCC method (Schumann and Klauke 2003). In brief, standard laboratory methods were used for the laboratory analyses. AST: BM/Hitachi Laboratory Accreditation Compliance Sheet: BM-GPT IFCC, cat. no. 1730575; ALT: BM/Hitachi Laboratory Accreditation Compliance Sheet: BMGoT IFCC, cat. no. 1552485.

Media and culture conditions

Fecal samples preparation, isolation, and enumeration of LAB and bifidobacteria

Fecal samples were collected freshly from animals after defecation, within 1 h, the samples then homogenized in sterilized saline, diluted into different concentrations and incubated under the aerobic conditions and under microaerobic conditions (for enumeration of lactobacilli). As well as under anaerobic conditions for enumeration of bifidobacteria. Colony-forming units were counted. In detail, ten grams of feces were homogenized with a stomacher (John Morris Scientific Pty. Ltd., Melbourne, Australia in 90ml Rogosa and Sharpe (MRS) broth supplemented with 0.5% L-cysteine as first dilution and then diluted with 0.85% NaCl, 0.1% peptone and 0.01% cysteine; pH 7.0. Serial dilutions were spread onto Rogosa agar for counting of lactobacilli, Rogosa and Sharpe (MRS) supplemented with 0.5% L-cysteine for count of LAB and the growth of bifidobacteria (Haddadin et al. 2004), and MRS supplemented with 100 mg/l neomycin sulfate, 15 mg/l nalidixic acid and 3 g/l lithium chloride for the recovery of bifidobacteria (Laroi and Martin 1999). Plates were incubated in BBL anaerobic jar (Becton Dickinson Microbiology Systems, Sparks, MD) provided with disposable BBL gas generating pack (CO2 system envelopes, Oxoid, Ltd., West Heidelberg, Victoria) at 37˚C for 48 h.

HISTOLOGY

Specimen from organs; liver and colon were fixed in 10% neutral buffered formalin. Sections were routinely processed for light microscopy with formalin fixation, embedded in paraffin and stained with H and E according to (Bancroft et al. 1996). All sections were coded and analyzed blindly by the pathologist without knowledge of related characteristics or diet. Histological results have been graded by a scale from 0 to 4 according to severity of histological sections. 0 shows no histopathological results, 1 shows light degree of severity, 2 mild, 3 moderate and 4 severe histopathological results.

Biostatistics Studies

The data analysis was carried out with SPSS Inc. software (version 15.0). One-way ANOVA was used to study a significant difference between means of the dietary groups with a significance level of $P<0.005$ and $P<0.0001$. When ANOVA analyses revealed differences among the rat groups, post-hoc analyses identified where the differences existed (Tukey HSD Test). All data are presented as ± Standard Error of Means (SEM).

RESULTS

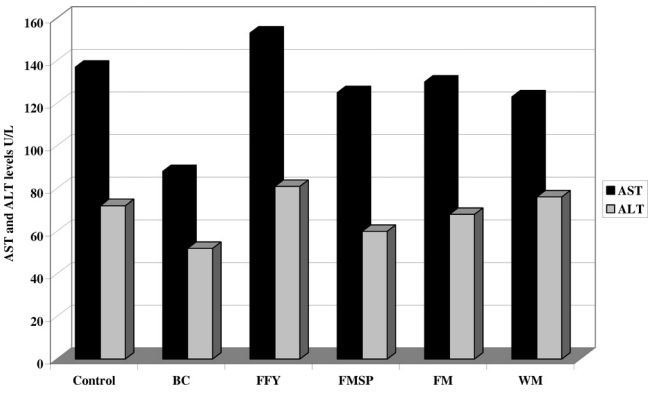
Body weight of rats

Table 3. Mean weight (g) changes in rats treated with different diets

Group of rats	Initial body weight	Final body weight	Weight gain (g)	%Weight gain
Control	130.0±4.99	223.0±4.16	93	72
BC	121.0±2.70	184.0±4.20	63	52
FFY	118.0±0.60	191.0±2.30	73	61
FMSP	120.0±1.90	198.0±1.30	78	65
FM	119.0±1.30	196.0±3.26	77	65
WM	119.0±1.69	200.0±2.10	81	68

BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk, ± SEM, n=6, (P=1.000000), Tukey HSD Test.

In Table 2 all rats were generally healthy throughout the feeding experiment period. The starkest observation of this table is the effect of BC diet group compared to all treatments. WM diet group showed the highest percentage of weight gain compare to dairy diet group. Surprisingly, the control diet group achieved the highest percentage of body weight gain across the experimented diets.



BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk. AST: aspartate aminotransferase, ALT: alanine aminotransferase (P<0.0001).

Figure 1. Serum levels of ASAT and ALAT distribution among different diets

Fig. 1 shows a significant reduction (P<0.001) of AST and ALT in BC diet group compared to other rat diet groups. On the other hand, FFY diet group increased markedly both AST and ALT compared to control and other groups. Other diets specifically FMSP decreased level of hepatic enzymes apart from whole milk which increased ALT.

Table 4. Effect of different diets on serum sodium and potassium ion levels

Groups of rats	Na^+ mEq/L	K^+ mEq/L
Control	144±1.23	4.2±3.19
BC	141±2.00	6.4±4.37
FFY	140±0.30	6.5±2.26
FMSP	141±2.50	6.1±2.59
FM	146±1.80	6.3±1.20
WM	142±2.03	6.6±1.56

BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk. ± SEM, values are the mean of no less than 3 results, n=6. Results are statistically significant from other rat groups (P<0.001).

Table 4 shows the level of sodium ions in experimented diets; low serum levels of sodium have been noticed in all groups except FM diet that compared to control group.

In contrast to sodium results, Table 4 shows the level of potassium ions in experimented diets, potassium levels were increased in all diets compared to control diet group.

Table 5 display the percentage of increasing levels of IgG, IgM, IgA, over control group and TNFα levels as noticed. The starkest increase of Igs has been noticed in BC, WM, and FMSP diet group. The IgG results demonstrated that, BC diet has the greatest increase over control group and represent 125%. While WM diet increased levels of IgM and IgA by 130.7% and 131.6% over control respectively. On the other hand, the level of TNFα indicated to normal changes compared to control group. The measuring range is 0.39~25 ng/mL according to the manufacturer.

Table 5. Effect of different diets on immunoglobulin groups and tumor necrosis factor alpha

Groups of rats	IgG ng/ml	% increase over control	IgM ng/ml
Control	1066±4.26	0	181±3.55
BC	1336±3.04	125.30	207±4.23
FFY	1110±5. 07	104.10	202±2.23
FMSP	1160±3.20	108.80	195±5.00
FM	1134±4.23	106.38	206±2.26
WM	1023±2.29	96.00	236±3.23

Groups of rats	% increase over control	IgA ng/ml	% increase over control	TNFα ng/ml
Control	0	61±1.29	0	0.28±4.30
BC	114.40	77±3.20	125.80	0.35±5.20
FFY	111.60	79±4.61	129.20	0.36±4.60
FMSP	107.90	83±3.00	135.80	0.41±3.91
FM	113.90	65±5.20	106.00	0.40±4.70
WM	130.70	81±4.00	131.60	0.37±2.20

BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk, ± SEM, values are the mean of no less than 3 results, n=6. a Results are statistically significant among all rat groups (P<0.001).

Liver histology

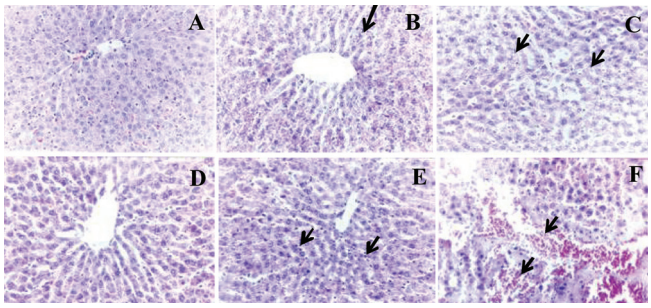


Figure 3. Liver histology

Liver of rats of control group showing normal histological structure of hepatic lobule **(A)** (grade 0) (H and E X 200). Liver of rats fed on **FMSP** diet showing slight hydropic degeneration of hepatocytes **(B)** (grade 1). Liver of rats fed on **FFY** diet showing vacuolar degeneration of hepatocytes **(C)** (grade 2). Liver of rats fed on BC diet, showing no histopathological changes **(D)** (grade 0). Liver of rats of **WM** group showing Kupffer cells activation **(E)** (grade 3). Liver of rats fed on **FM** showing focal hepatic hemorrhage dispersed the hepatocytes far away each other cells activation **(F)** (grade 4).

Colon histology

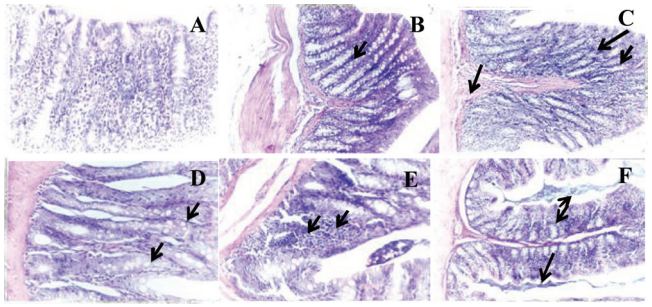


Figure 4. Colon histology

Colon of rats of control group showing normal mucosa **(A)** (grade 0) (H and E X 200). Colon of rats of **FMSP** diet group showing hyperactivation of mucous secreting glands **(B)** (grade 1). Colon of rats of **FFY** diet group showing hyperactivation of mucous secreting glands (small arrows) associated with leucocytic cells infiltration in lamina propria (large arrows) **(C)** (grade 3). Colon of **BC** diet group showing hyperactivation of mucous secreting glands **(D)** (grade 1). Colon of **WM** diet showing focal mononuclear cells aggregation in lamina propria (arrows) **(E)** (grade 2). Colon of **FM** diet group showing hyperactivation of mucous secreting glands (small arrows) associated with accumulation of basophilic mucous in the lumen (large arrows) submucosal edema arrows **(F)** (grade 4).

Microbial populations in dairy products

Table 6. Count of lactobacillus bacteria (LAB) and the growth of bifidobacteria in dairy products (CFU/ml) samples using different selective media

Dairy product	MRS-C (LAB and Bifidobacteria)	MRS-NNL (Bifidobacteria)	Rogosa (Lactobacilli)
FFY	20x108	7x108	12x107
FMSP	35x107	0	15x107
FM	15x106	0	10x106
BC	30x102	0	30x102
WM	0	0	0

BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk

Table 6 microbial populations in dairy products show the total counting of lactobacillus and bifidobacteria. Bifidobacteria was only found in FFY (7x108 cfu log10/g). Lactobacillus was ranged from 0, 30x102, 10x106, 15x107, and 12x107 for WM, BC, FM, FMSP, and FFY products respectively. Surprisingly there is no bifidobacteria detected in fermented milk supplemented with probiotic.

Microbial populations in feces

Table 7. Count of LAB and the growth of bifidobacteria in animal feces samples (CFU/gm) using different selective media

Group of rats	MRS-C (LAB and Bifidobacteria)	MRS-NNL (Bifidobacteria)	Rogosa (Lactobacilli)
FM	75x108	15x107	12x108
BC	65x108	10x107	15x108
FFY	35x108	5x107	10x107
Control	20x108	2x103	30x104
FMSP	70x108	7x105	20x107
WM	45x103	0	0

BC=Buffalo colostrum, FFY=full fat yoghurt, FMSP=fermented milk supplemented with probiotic, FM= fermented milk, WM= whole milk.

Total microaerobes ranged from 0 to 9.92cfu log10/g of fresh fecal weight of rats across all experimented diets Table 7. Fecal samples from all diets showing increase total microaerobes and anaerobes counts compared with the samples from control group. Rats fed on WM diet showed a lower concentration of total aerobes and microaerobes in the feces samples compared with control group. The FM, FMSP and BC diet groups showed a significant increase in microaerobes and anaerobes compared to control group.

DISCUSSION

The current work was conducted to compare the effect of consumption of different dairy products which are usually consumed as a part of an Egyptian diet; buffalo colostrum (BC), full fat yoghurt (FFY), fermented milk (FM), fermented milk supplemented with probiotics (FMSP), and whole milk (WM) in rats. Different parameters were carried out; immunological, histological, bacteriological and biochemical will be discussed.

Immunity

The effect of different experimented diets were conducted on rats' serum on the humoral immune response at the levels of immunoglobulin classes IgA, IgG and IgM by enzyme linked immune sorbent assay (ELISA). The starkest increase of Igs has been noticed in BC, WM, and FMSP diet. The increased levels of immunoglobulin IgG indicate to an activity that influences the natural and adaptive immune systems (Heyman et al. 1988)

The levels of IgG, IgM and IgA over control Table (4); IgG results demonstrated that BC diet group has recorded the greatest increase over control group and represent 125% that excelled all products compared to control group. The results of David and co-workers (2007) studied the safety of New Zealand bovine colostrum on nutritional and physiological evaluation in young rats. They found no difference in colostrum-fed animals and the control group body weight, food consumption, clinical signs, hematology and most parameters of blood chemistry including carbohydrate metabolism, liver function

and kidney function. The difference between our results and previous results that they used young rats for 90 days which were fed on colostrum at 3% and 10% basal diet but the current study used adult rats and buffalo colostrum diet for only 30 days.

Tumor necrosis factor alpha is 17.5 kDa, 157 amino acids; it is the primary mediator of immune regulation. The biosynthesis of TNF-alpha is tightly controlled being produced in extremely small quantities in quiescent cells, but is a major secreted factor in activated cells. The level of TNFα indicated to normal changes compared to control group, this may be due to the natural effect of milk products.

Histology

Histology of liver and colon

We graded the histopathological results from 0 to grade 4 as mentioned in the materials and methods. The best results have been noticed in BC diet group that achieved grade 0 and 1 for liver and colon respectively. In contrast, fermented milk achieved grade 4 for both organ tissues compared to control group Fig. 3 and 4. These results may need further investigations to explain the effect of fermented milk on tissues. Colon of rats treated with FM showing hyperactivation of mucous secreting glands associated with accumulation of basophilic mucous in the lumen submucosal edema arrows that graded into 4.

It was previously reported that fermented milk had increased the number of beneficial microflora, but the current results specifically histological results indicated that the colon condition has not improved. Although the time span of the experiment was only 4 weeks it would be suggested that the high concentrations of organic acids, arising from rapid fermentation of prebiotics by probiotics that inhibit the colonization of acid-sensitive pathogens, could also induce injury to the intestinal mucosa and hence, impair its barrier function (Remesy et al. 1993 and Bernet et al. 1994).

It must also be noted that rats fed on buffalo colostrum diet group were on the same scale as the normal group. Hierarchically, FMSP diet group came in third place after BC diet group that may be explained that probiotic action may not necessarily be related to alterations in the composition of the microflora of the large bowel but could have an effect in the small bowel, where the intestinal ecosystem is first exposed to the diet microbes or as we noticed the absence of some probiotics labeled on the product.

Bacteriology

Dairy products microbial population

Probiotic bacteria such as Lactobacillus are generally regarded as safe (GRAS) for consumption. Until now, reports of harmful effects of these microbes toward a host are rare and their safety has not been questioned. Our results show that Bifidobacteria was only found in FFY product, (7x108 cfu log10/g) compared to other dairy products. There was an increase in the population of lactobacilli and bifidobacteria in fermented milk, and FMSP, total microaerobes and anaerobes were ranged from 0, 30x102, 10x106, 15x107, and 12x107 for WM, BC, FM, FMSP, and FFY respectively.

Recent research shows that yoghurt bacteria are able to survive in the passages of the small intestine. The beneficial effects of dairy products may be due to the high production of lactic acid that indicates the possible antimicrobial capability on pathogenic microorganisms. Most feeding dairy studies links between nutrients and microflora composition have been done with supplements such as viable bacteria (probiotics), but in this study we used commercial dairy products. The current results indicate to the beneficial effect of FMSP diet that contributed to a higher concentration of LAB that agreed with Haddy (1991).

Feces microbial population

Fecal samples from all experimented diets showed an increase in total microaerobes and anaerobes count compared to the samples from control group. Normally rats fed on WM diet showed the lowest concentration of total aerobes and microaerobes in the feces due to pasteurization process of milk. The FM, FMSP and BC diets showed a marked increase in microaerobes and anaerobes consecutively compared to other groups. Results indicate that there was an accumulation of probiotics in feces throughout the 30 days feeding time.

Biochemical analysis

Results from this study also showed a significant decrease of AST and ALT in BC diet group compared to control diets. On the other hand, FFY diet increased both AST and ALT compared to control group. The immunomodulating capacity in vivo of the dairy products derived from this study indicates to the possible effectiveness of these products to promote health in some diseases such as hepatitis C virus (HCV), that may be suggested after extending the study on subjects specifically, the safety of BC product (Davis et al. 2007) and affordable.

The serum level of sodium ions in the experimented diets showed low levels of sodium in all groups except FM diet compared to control groups. Levels of serum potassium ions were increased in all experimented diets compared to control diet. A number of animal, epidemiological, and clinical studies supports that dietary potassium can reduce blood pressure (Linas 1991 and National Institutes of Health 1997). It has been suggested that high intakes of dietary potassium may protect against the development of hypertension and improve blood pressure control in those who have high blood pressure (Laura et al. 1999).

Additional health benefits of dairy foods, a multicentre study of more than 450 adults found that a low fat diet rich in dairy foods (roughly three servings a day), fruits and vegetables (known as the DASH diet) significantly reduced blood pressure within two weeks. A recent reanalysis of this study found that the DASH diet significantly lowers blood pressure (but the level of statistical significance is not indicated) in almost subgroups of adults studied (e.g. men and women, older and younger adults, obese and lean individuals, African Americans, sedentary and active individuals (Whelton et al. 1997).

CONCLUSIONS

The main aim of this study was to compare the potential effects of some dairy products on rats. Immunological, histological, bacteriological and biochemical parameters were carried out. The BC and FMSD diet groups demonstrated an improvement of parameters proposed. BC diet may be suggested to use in controlling weight programmes, improve liver functions. However, FM diet group showed the least improvement compared to the control group. Generally, clear labeling for dairy products and insurance of the quality control of dairy products is needed. All the experimented dairy diets result in low sodium and increase potassium ion levels in the serum apart from control group.

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