

MILK-FREE FOOD

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Cow's milk is composed of water, proteins, minerals and carbohydrates. The proteins are casein, lactalbumen, and alpha and beta lactoglobulin. While we must accept that cow's milk is an adequate food for most human beings, it is becoming increasingly evident that some children cannot tolerate whole milk, but can digest it when it is modified by dilution or by removal of the fat, and that some children are unable to take milk at all, because they are allergic to the proteins or the sugar. It is also evident that a child can progress very well and make adequate weight gains on a milk-free diet.

The purpose of this paper is not to produce a scientific contribution on milk allergy and the various proteins, or on galactosaemia and the enzyme defects, but to give some of the indications for exclusion or modification of milk, and particularly to give practical details of suitable diets at different ages.

Modification of Milk

Small and premature infants very often cannot tolerate the fat of cow's milk, and in their stomachs a coarse curd may result from the excessive amount of casein present. The policy in such children should be to use either a humanized milk in which proteins and fats are altered to give a similarity to breast milk, such as 'S.26', or evaporated milk such as 'carnation' or 'ideal' in which the milk is homogenized and the protein altered so that a smaller curd results. Children suffering from diarrhoea respond poorly to diets containing milk fat, and should be fed on skimmed milk, fresh or dried, with or without the addition of lactic acid, until the stools are completely normal.

INDICATIONS FOR THE EXCLUSION OF MILK FROM THE DIET
Milk should be excluded from the diet in 3 conditions: milk allergy, galactosaemia, and lactosuria.^{4a}

Milk Allergy

Allergy to milk may manifest itself in many ways. New-born and young infants may suffer from severe colic and vomiting. A temporary phase of allergy to milk is sometimes seen after an acute diarrhoeal episode. Babies who were able to tolerate milk well become ill with acute gastroenteritis. They recover well from the acute episode, but their subsequent course is one of recurrent bouts of diarrhoea, loss of weight, and, if the condition is not checked, often death. The use of a milk substitute will produce a dramatic change in most cases.

In the newborn, milk allergy may be dramatic. There is evidence that cow's milk taken in the first 5 days of life can produce a vigorous response to antibodies.⁵ These children mostly do not show clinical evidence of allergy. However, it is now thought that many of the sudden cot deaths may be due to anaphylaxis produced by the effect of inhaled vomited milk.¹² Parish *et al.* in 1960 produced evidence in favour of this. The level of agglutinating antibodies to cow's milk was measured in 286 normal children aged 7 weeks—2 years, and in 24 infants who had died suddenly. Titres were much higher in the latter. Guinea-pigs sensitized to cow's-milk protein, died rapidly after the introduction of cow's milk obtained from stomach contents of infants who had died suddenly, or after introduction of 1% solution of casein, or 1% solution of lactoglobulin into the air passages.⁶

Haemagglutination. There is much doubt about the value of haemagglutinin and precipitin tests for the detection of antibodies to the protein in cow's milk. These are apparently found in many healthy people, and in children with sundry diseases which do not respond to exclusion of milk from the diet, such as pulmonary haemorrhage, coeliac disease, Aldrich's syndrome, iron-deficiency anaemias, and severe mental retardation.^{7, 8, 13} On the other hand, other studies have found that patients with gastro-intestinal dysfunction and high precipitin titres may improve considerably on milk-free diets.¹⁰ It must be concluded that the best test for milk allergy is the clinical one of observing the effect of stopping the ingestion of milk, and that, as yet, antibody tests are too difficult to assess to be helpful.

Asthma, eczema, rhinitis. In patients with asthma, eczema and allergic rhinitis where a specific cause is not known, a period of milk exclusion is always worth trying. Very often one is startled by the improvement in the patient. In patients with eczema, the feeding of milk seems to be the cause of the disease even without external allergens. This point is disputed in a paper by Friedman in 1961,³ who feels that cow's-milk allergy is not an important factor in infantile eczema. In hay fever and asthma it is felt that the condition is not so much an allergy to milk as an alteration of some threshold of response.¹¹ The asthmatic child, e.g. taking a milk-free diet, will respond less or not at all to the allergens which usually brought on an attack, if he has an underlying milk sensitivity.

Diner and his colleagues,¹ in 1961, described 8 children with chronic respiratory disease and poor weight gain. In all these multiple circulating precipitins to cow's milk were found. Five children also suffered from pallor, frequent vomiting and diarrhoea, and recurrent otitis. Three of these patients became healthy spontaneously at the ages of

14, 21 and 30 months. Four who did not recover spontaneously recovered completely when milk was withdrawn from the diet. One was not followed-up. 2,000 other patients were tested at random, and in none were these precipitin bands found. The authors stress, however, that other investigators have found precipitin bands in normal children.

In 1961 it was shown¹⁴ that some patients with ulcerative colitis had antibodies to cow's milk in their serum.

It thus seems that milk allergy is a very real disease, and may manifest itself as sudden death, infantile colic and vomiting, ulcerative colitis, hayfever, asthma, eczema, and as chronic respiratory disease associated with poor weight gain. In any of these conditions, excepting the first, a period of abstinence from milk is worthy of trial. Skin tests to milk may be positive, and where facilities for such tests are available, it would be helpful to look for antibodies in these patients. However, in all food allergies, a trial of abstinence is probably the best diagnostic tool.

Lactosuria

In December 1963 a syndrome of lactosuria was described in 2 patients with failure to thrive, aged under 1 year, who excreted lactose in the urine with disaccharide laevulose. Both were on cow's milk formulae. It was suggested that there was a temporary deficiency of the enzyme B. galactosidase in the intestine. The condition was cured by a period on 'nutramigen'. The deficiency was overcome by the age of 1 year.⁴

Galactosaemia

This disorder is an inborn error of metabolism, probably transmitted as a homozygous recessive gene.⁹ An enzyme deficiency interferes with the transformation of galactose-1-phosphate to glucose-1-phosphate. Galactose levels in the blood increase, and a syndrome of hepatomegaly, jaundice, cataract, mental retardation and aminoaciduria results. The diagnosis is made by finding galactose in the urine, associated with an increase of aminoacids, and the raised blood galactose levels. Treatment with a completely milk-free diet, both breast and cow's milk, must start as early in life as possible if the severe complications are to be prevented.²

THE MILK-FREE DIET

The diet will vary with age, and the following description will be of the average diet for a child from birth onwards. It will be assumed that all these children are bottle fed. In galactosaemia breast feeding must be stopped as soon as the diagnosis is established, and cow's-milk allergy is naturally a problem if the child is fed on cow's milk.

A normal diet consists of milk feeds in infancy, with solids added usually at 3 months of age, but occasionally much earlier. At about 9 months the child is fed on 3 meals daily (breakfast, lunch and supper), with milk feeds on waking, and following at least 2 of the main meals. At about 1 year the early morning milk feed is dropped, and the child continues on 3 meals daily with drinks, and sometimes a snack between the 3 main meals.

SUBSTITUTES FOR MILK FEEDS

The usual substitutes for milk are 'mullsoy', 'nutramigen', and 'allergilac'. *If the patient is severely ill and underweight, breast milk should be obtained.*

Breast milk is invaluable in the treatment of the ill and small child who is intolerant of cow's milk. It can be obtained from the bank of the South African Institute for Medical Research, and is supplied in 20-ounce bottles. In any hospital with a maternity section, it should be easy to obtain a supply of expressed breast milk. Expressed breast milk is usually in short supply, and from the bank it is very expensive, so it should be reserved for really ill cases.

Mullsoy

A product of the Borden company. It is made of soy flour, soy oil, sugar, dextrose, calcium and sodium phosphate, soy lecithin, 4% of soy fat and 4.5% of carbohydrate. Its caloric value is 20 calories per fluid oz. when reliquified. It is a most valuable substitute for cow's milk. It is a powder which is made into a fluid by mixing 1 level measure with 2 oz. of water. It is best to make a paste with a small amount of cooled boiled water, and to add the rest of the water required gradually, stirring all the time. Sugar should be added, and the child will need additional vitamins.

Nutramigen

A product of Mead Johnson. It is made from enzymically hydrolyzed casein, sucrose, arrowroot starch, corn oil, vitamins and minerals. The food is complete, and no extra sugar or vitamins are required. The caloric value is 20 per fluid oz. of the liquified product. One level measure of powder is mixed with 2 oz. of water. To prepare it the powder is placed on the surface of the boiled warm water, and mixed with a fork or beaten until smooth.

Nutramigen is considered by most authorities to be the safest preparation in cases of galactosaemia. It has been said to contain a trace of lactose, but results with its use have been good. Soy-bean preparations have been considered dangerous¹³ because they contain a tetrasaccharide, stachyose, which yields 2 molecules of galactose when hydrolyzed. Many authors feel soy-bean preparations are quite safe but with this slight yield of galactose, it is better not to use them.

Allergilac

A modified cow's milk preparation made by 'Cow & Gate'. It contains half-cream dried milk from which the greater part of the lactalbumen has been removed, and the remaining proteins modified with reduction of allergenic power. At full strength 1 level measure, or 1 slightly heaped teaspoonful is mixed with 1 oz. of water. It should be made up in the same way as mullsoy.

In changing to any of these feeds it is wise to proceed slowly. After stopping milk, the first 2 feeds should be of dextrose water, or an electrolyte solution, and then the chosen preparation given in half-strength feeds, and gradually worked up to full strength.

All these preparations are expensive, nutramigen being the most expensive, and allergilac the least. They should be ordered through a hospital when they are too expensive for the parents. One wonders if high-protein soup powders such as 'protone' or 'prokl'f could not be used with safety, but there have been no trials so far. 'Pronutro' was used as sole feed in malnutrition patients in Durban and clinical results and serum protein estimations were satisfactory but since pronutro contains milk protein, it is of no use in milk allergy.

A comparison of the composition of cow's milk and its substitutes is made in Table I.

TABLE I. COMPARISON OF COW'S MILK AND ITS SUBSTITUTES IN PERCENTAGES OF THE TOTAL FLUID

| | Cow's milk | Breast milk | Mullsoy | Nutramigen | Allergilac |
|-----------------------------|-------------|-------------|---------|------------|------------|
| Protein-total .. | 3.2-4 | 1.0-1.5 | 3.1 | 2.2 | 3.3 |
| Lactalbumen .. | 0.5 | 0.7-0.8 | — | — | 0.1 |
| Casein .. | 3.0 | 0.4-0.5 | — | — | 3.2 |
| Fat .. | 3.5-5.2 | 3.5-4 | 4.0 | 2.6 | 2.0 |
| Carbohydrates .. | 4.5-5.0 | 6.5-7.5 | 4.5 | 8.5 | 5.4 |
| Total minerals .. | 0.7-0.75 | 0.18-0.25 | 0.7 | 0.6 | 1.0 |
| Calcium .. | 0.122-0.179 | 0.034-0.045 | 0.13 | 0.1 | 0.09 |
| Phosphorus .. | 0.090-0.196 | 0.015-0.040 | 0.11 | 0.07 | 0.06 |
| Iron .. | 0.00004 | 0.0001 | 0.004 | 0.001 | — |
| Calories per fluid ounce .. | 20. | 20. | 20. | 20. | 15.4 |

FOODS OTHER THAN BOTTLE FEEDS

It is first necessary to know which foods contain milk, so that they can be avoided. These include ice-cream, milk puddings, many cakes and some biscuits, scones, white sauce, custard, mashed potatoes and cheese. Butter is harmless in milk-allergy patients, and can be used to provide extra calories. It is made almost entirely of milk fat. It should not be given to patients with galactosaemia.

The parents, and the child, if old enough, must be instructed that these foods should be avoided. Special puddings and cakes may be made for the affected child, but it is usually simpler to prepare them for the entire family.

Milk-containing Feeds

Drinks normally made with milk can be made with one of the substitutes mentioned earlier. Small children may just drink the substitute sweetened with sugar, or a little tea can be added. These drinks can be poured over porridge, and baby cereals can be made up with them.

Porridge. Any ordinary breakfast porridge, mealie-meal, oatmeal, or Maltabella can be made with water, sweetened with sugar, with the addition of a little butter or margarine. Mullsoy or another substitute can be poured over it. Baby cereals can be made in the same way, or made up with a substitute. Nutrine contains a small amount of lactose and should therefore not be used if a milk-free diet is required.

Eggs. Scrambled eggs or omelettes are very palatable if about 2 teaspoonfuls of water are beaten up with each egg.

Meat. Any meat dish is suitable, and extra meat should be offered if possible to make up for any protein lack incurred in the milk-free diet.

Vegetables. All vegetables are suitable. Mashed potatoes can be prepared by adding margarine or butter, a little cold water, and beating well.

White sauce. Recipes for white sauce usually suggest that a roux of butter and flour is made with the addition of hot milk. A far pleasanter white sauce can be made by using the stock from the fish meat, or vegetable. The appearance is better if a little milk is added, but its taste and consistency are the same if stock only is used.

Batter for coating fish, or making batter and fritters can easily be made without milk.

The ingredients are: 4 oz. of flour, a pinch of salt, 1 tablespoonful of olive oil or salad oil, about a ¼ pint of tepid water and 2 egg whites stiffly beaten.

The instructions are: Sieve the flour and salt into a basin. Put the oil and half the water into a well in the centre. Draw in the flour from the sides, mix and beat until smooth. Add sufficient water to bring to a coating consistency. Just before using fold in the stiffly beaten egg whites.

Puddings. The usual milk puddings, rice, sago, tapioca and junket have to be abandoned. Semolina can be prepared with water and eggs, and eaten with a spoonful of jam, but the consistency is not as pleasant as that made with milk.

Many puddings do not normally require milk, for example pies and tarts, lemon snow, jelly, stewed fruit, pureed fruit, and fresh fruit salad.

A few recipes will follow of puddings which can be made acceptable without milk.

Pudding Recipes

Chocolate pudding. Ingredients: 3 eggs, 2 oz. of sugar, a 5c-bar of chocolate (plain), a ¼ pint of water, and 1 dessertspoonful of gelatine.

Instructions: Melt the chocolate either in a double cooker, or in a pot over slow heat—add the beaten egg yolks, and stir thoroughly. Add gradually, stirring all the time, 6 table-spoonfuls of cold water. As soon as the mixture starts to thicken, remove it from the heat, and add the gelatine which has been dissolved in a dessertspoonful of cold water. When this mixture is cool, add the stiffly beaten egg whites, and mix very gently. Allow to set.

This pudding is even better, but too rich for small children, if a 10c.-chocolate bar is used, and quite a good pudding can

be made, if 2 tablespoonsful of cocoa dissolved in the cold water are used instead of the chocolate.

Orange soufflé. Ingredients: 3 eggs, 4 ounces of fresh orange juice, 2 oz. of sugar, a dessertspoonful of gelatine.

Instructions: Put the orange juice, sugar and egg yolks into a double cooker, or into a pot over warm water. Beat this mixture with an egg beater until it becomes frothy and doubles in quantity. Remove the mixture from the stove, and add the gelatine, which has been soaked in a little cold water. When the mixture is cold, add the stiffly beaten egg whites. Allow the mixture to set.

Variations on this pudding can be made with well-mashed bananas, pureed prunes, or grenadilla pulp.

Apple snow. This can be made by mixing a puree of cooked apples and sugar with well-beaten egg white.

Steamed pudding. This pudding requires so little fluid that the normal recipe can be used, and water added, if necessary, instead of the milk usually suggested.

Suet puddings do require a lot of milk, but can be made if for every 4 oz. of milk, 2 oz. of water and a beaten egg are substituted. These eggs will be in addition to the eggs already in the mixture.

Ice-cream requires milk and cream, but the child on a milk-free diet can be supplied with a home-made or bought fruit-juice sucker when the rest of the family eat ice-cream.

Custard. A pleasant-tasting fluid resembling custard can be made.

Ingredients: 4 oz. of water, 1 egg, 1 oz. of sugar, $\frac{1}{2}$ oz. of maizena and a teaspoonful of vanilla essence.

Instructions: Mix the maizena and water together until no lumps are present. Beat this mixture with the egg and sugar and stir it in a basin over hot water, or in a double cooker until it thickens slightly. Remove it from the stove and add the vanilla essence.

Cakes and biscuits. Where cakes and biscuits are bought, it is best to buy them from one reputable confectioner or baker, and to consult the manager of the shop about the suitability of his products.

Home baking is extremely simple. Where a recipe calls for no milk, as in rich fruit cake, water sponges and biscuits, there is no problem. Where a mixture requires very little milk such as in the standard Victoria sandwich mixture, merely substitute water for milk. In any recipe requiring a lot of milk, substitute 1 egg and 2 oz. of water for every 4 oz. of milk.

Scones. The ordinary scone requires milk, but a reasonable scone can be made using the egg and water mixture described above.

Bread. Most bread is made with water. Almost all ordinary bought loaves are milk free. Some of the fancier loaves are made with milk, and it is best to consult the baker. Home-made bread can be made with water, using any standard recipe.

REINTRODUCTION OF MILK

The patient with galactosaemia should be completely off any dairy product for at least 5 years. He should then be hospitalized, a baseline of several specimens of urine obtained, and if they are found to be completely galactose free, an attempt at introducing milk into the diet can be made. On the first day 1 teaspoonful of milk should be given, on the 2nd day two, the 3rd day three, and so on. All specimens of urine

passed should be tested, and if any sugar appears and this is found to be galactose, the patient must remain on diet for another 2 years, and then have the test repeated. If no sugar appears, milk can be given in reasonable amounts. The patient may go home when the test is over, but for the first 3 months the urine should be tested daily for sugar, and weekly for a year or two.

The patient with milk allergy should be off milk completely for 6 - 12 months, depending on the severity of the condition. An attempt can then be made at desensitization. One teaspoonful of milk should be added to a glass of water, and on the first day one teaspoonful of this mixture should be taken. Every day one more teaspoonful should be taken until the day's dose is the entire glassful. With the larger quantities this fluid should be mixed with the milk substitute, fruit juice, or tea, as it is otherwise an unappetizing drink. At this stage a full teaspoonful is being taken daily, and this can be increased by 2 teaspoonfuls every day until a half pint is taken daily. At this stage the patient can take a normal diet. It will take approximately 2 months to reach the teaspoon stage, and another 40 days to reach the $\frac{1}{2}$ pint. If at any stage the patient seems to relapse into the initial allergic state, the milk-free diet should be re-instated.

The infant with a temporary milk allergy following gastroenteritis can usually return to a milk-containing diet far more rapidly. After one or two weeks of substitute, one whole feed of suitably diluted milk can be given. If no diarrhoea results after 24 hours, 2 feeds of cow's milk can be given the next day, three the next, and so on until the child is on a normal diet.

SUMMARY

A brief summary of the indications for a milk-free diet has been given. These include galactosaemia, and most of the manifestations of milk allergy. A description of milk substitutes for the bottle-fed infant has been given, and some ideas supplied to feed the older child without milk. Finally 2 schemes are outlined for reintroducing milk into the diet.

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