

DEPARTMENT OF NUTRITION AND DIETETICS

**Dietary information for adolescents & adults
with
Trimethylaminuria (TMAU)**

Choline Restricted Diet

Metabolic Dietitians

Tel: 020 3448	3604	Charlotte Ellerton Charlotte.Ellerton@uclh.nhs.uk
	3605	Heidi Chan Heidi.chan@uclh.nhs.uk
	4332	Clare Gray Clare.gray@uclh.nhs.uk
	3602	Francine Freedman Francine.freedman@uclh.nhs.uk

Bleeps: 8197/8198

If you would like this document in another language or format, or if you require the services of an interpreter, contact us ☎ 0207 380 9289.

Turkish

Bu belgenin Türkçe'sini edinmek ya da Türkçe bilen birisinin size yardımcı olmasını istiyorsanız, bize başvurabilirsiniz.

Bengali

যদি আপনি এই ডকুমেন্ট অন্য ভাষায় বা ফরমেটে চান অথবা যদি আপনার একজন ইন্টারপ্রেটারের প্রয়োজন হয়, তাহলে দয়া করে আমাদের সাথে যোগাযোগ করুন।

Cantonese

本文件可以翻譯為另一語文版本，或製作成另一格式，如有此需要，或需要傳譯員的協助，請與我們聯絡。

Polish

Jeżeli chciałoby Państwo otrzymać ten dokument w innym języku lub w innym formacie albo jeżeli potrzebna jest pomoc tłumacza, to prosimy o kontakt z nami.

Russian

Если вы хотели бы получить этот документ на другом языке или в другом формате, или если вам необходимо воспользоваться услугами переводчика, просим обращаться в администрацию.

Mandarin

本文件可以翻译为另一语文版本，或制作成另一格式，如有此需要，或需要传译员的协助，请与我们联系。

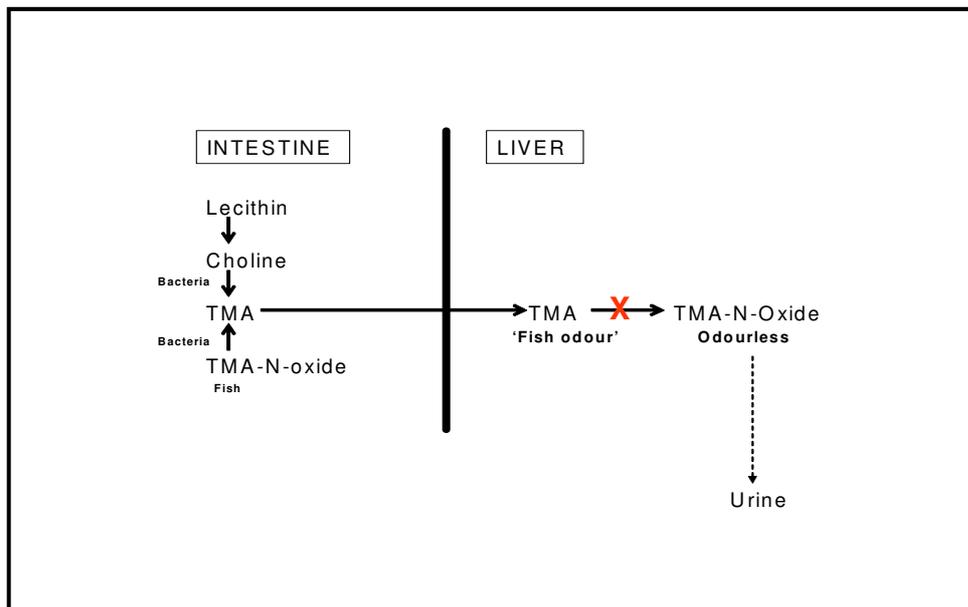
Contents	Page no
Introduction	4
Symptoms of TMAU	4
What causes TMAU?	4
Clinical diagnosis	5
Clinical management	5
Dietary management	6

Introduction

Trimethylaminuria (TMAU)

TMAU is a disorder in which the body is unable to break down trimethylamine (TMA), a compound derived from the diet that has a strong odour of rotting fish. It is an inherited condition resulting in a deficiency of the enzyme which changes the odourous trimethylamine (TMA) into the odourless N-oxide trimethylamine (TMA-O) (see Figure 1). TMAU, also known as the “Fish malodour syndrome” is characterised by the presence of abnormal amounts of TMA in urine, sweat, breath and other bodily secretions.

Figure 1: Trimethylamine metabolism



Symptoms of TMAU

Malodorous TMA (which gives fish its fishy odour) builds up and is excreted in the urine and body secretions such as sweat, reproductive fluids, saliva and breath, giving off a strong unpleasant body odour similar to rotten fish. The severity is variable. Some individuals have a strong odour all the time but it can be episodic and varies in intensity over time. Sweating, menstruation and a diet high in trimethylamine and its precursors may worsen symptoms.

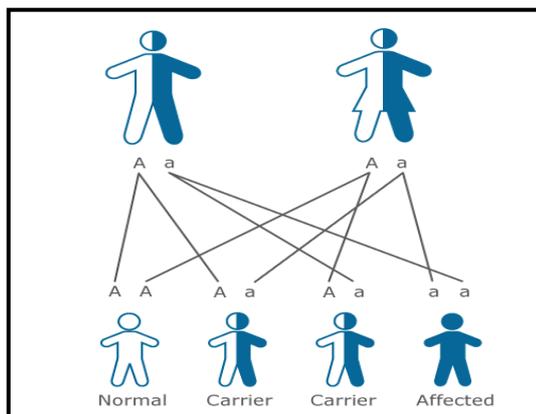
What causes TMAU?

There are various proposed classifications for TMAU. At this centre we classify TMAU into two major subgroups: 1) primary (genetic) and 2) secondary (acquired).

TMAU, in its primary form, is an autosomal recessive disorder. This means two copies of the FMO3 mutation, one from each parent, are needed to inherit TMAU. Any person with one copy of the mutation can pass it on to their children (see **Figure 2**). Primary TMAU is characterised

by a high TMA/TMA-O ratio. In patients with primary TMAU, symptoms are usually present from birth and the condition may worsen with puberty.

Figure 2: Primary TMAU



Although genetic mutations account for most cases of TMAU, it can also be caused by other factors. A fish-like body odour may result from an excess of certain proteins in the diet or from an increase in bacteria that normally produce TMA in the gut. Secondary TMAU is characterised by a high concentration of TMA in the urine, but a normal urinary TMA/TMA-O ratio. Temporary symptoms of this condition have been reported in a small number of premature infants who are fed a choline-containing infant formula and in some healthy women at the start of menstruation

Clinical diagnosis

TMAU diagnosis is determined by the ratio of TMA to TMA-O in the urine. Patients are requested to substantially increase choline intake by eating foods such as fish and eggs a day before the urine collection. The test can be repeated to assess changes in urinary TMA excretion after intervention. It usually takes 6 – 8 weeks for the test results to come back. Gene mutation analysis can confirm primary TMAU.

Clinical Management

Symptoms may be managed through dietary restrictions, non-dietary methods or a combination of both these approaches.

The main treatment strategies are:

- Choline and lecithin restricted diet
- Short courses (typically two weeks) of antibiotics: Antibiotics (metronidazole, neomycin, amoxicillin and doxycycline) reduce the activity of the gut microflora and suppress the generation of TMA. Rotation of antibiotics every few months prevents antibiotic resistance.

- Use of probiotics after a short course of antibiotics. All gut bacteria are suppressed by the antibiotics, and by taking probiotics the gut flora can be modified. This will increase the number of Lactobacilli and Bifidobacteria species which are not thought to metabolise choline to TMA.

There are numerous types of probiotic supplements available in supermarkets, pharmacies and health food shops. Probiotics in **tablet** or **sachet** form tend to contain a greater number of bacteria than drinks or yoghurts, so these may be more effective. It is important to stop taking probiotics whilst you are completing a course of antibiotics. Please check that your supplement does not contain lecithin, soya lecithin or choline.

- Use of gut absorbers (charcoal / copper Chlorophyllin). These can be useful in the management of TMAU by binding some of the free choline and TMA in the gut and allowing it to be excreted, rather than absorbed into the body. Research has shown that taking these supplements can reduce free urinary TMA, suggesting that they can help with symptom control. The two main supplements are activated charcoal or copper chlorophyllin. Available online at www.Nullo.com / <http://www.bodymint.com> or at a health food shop.
- Use of Riboflavin (Vitamin B2). Riboflavin is a co-factor for the FMO3 enzyme, which means it can help to enhance the activity of the enzyme. Riboflavin is often included in many multivitamin supplements but larger doses are required to aid FMO3 enzyme activity. Tablet preparations are available from health food shops as 100mg tablets, and the usual dose is between 90 – 200mg/day.
- Although TMAU is **not related** to personal hygiene it might be useful to use soaps with a moderate pH (5.5-6.5). As TMA is an alkaline compound (pH 9.8), using a lower pH body wash or moisturiser can make the TMA less volatile and easier to remove through washing (see table 1 on page 11)
- Multivitamins. We do not routinely insist all patients take multivitamins, but if you are concerned that your diet is very strict or that you may be at risk of vitamin and/or mineral deficiencies then please discuss this with your dietitian and/or consultant. One of the reasons we aim to see everyone who is following the diet on a regular basis is to check blood tests for any indication of nutritional deficiencies.

Dietary management

It is relatively easy to exclude foods high in TMA, but TMA can also be produced by bacteria in the gut from choline. Choline is present in food, but it can also be synthesised by the body. By reducing the amount of choline (and to a lesser extent, TMA) that enters the body through diet, this reduces the production of TMA in the gut and therefore can help with symptom control

Aims

- Restrict intake of food containing large amounts of choline and lecithin, which can lead to a reduction in odour
- Ensure adequate nutrition status. Dietary management should ensure that individuals meet the daily choline recommendations for age and gender.
- Maintain appropriate weight and avoid rapid weight loss

Dietary principles

- Avoid the major sources of choline: eggs, offal, soya and soy products, beans, legumes, nuts, wholegrain cereals, Vitamin supplements, medicines and fortified foods containing choline or fish oils.
- Read labels of convenience and manufactured foods. Avoid if Lecithin (E3220) or Soy lecithin (E471) is listed. Lecithin, of which choline is a constituent, is a commonly used emulsifier added to foods such as ice-cream, mayonnaise, chocolate and many other manufactured foods and should be avoided.
- Sea and saltwater fish is the main dietary source of TMA-O and, therefore, should be avoided. Freshwater fish may be eaten freely.
- Select a wide variety of foods from the 'GREEN LIST' (page 8) - when on a restricted diet it is important to choose food carefully and include a wide range of foods from the freely allowed list
- Prepare foods freshly – fresh foods and basic ingredients are best
- Dietary supplements – take only those dietary supplements recommended by your doctor or dietitian
- Maintain a healthy weight – weight should be monitored on a regular basis

Low levels of choline are present in many foods therefore it is impossible to avoid all dietary choline and provide a healthy diet at the same time. All information regarding the choline content of food and drink is obtained from the USDA database for the choline content of common foods, as there is no UK equivalent. Whilst this list continues to expand, it is not exhaustive and there are no details for many foods. Patients are encouraged to try different foods and assess their symptoms (For a more comprehensive list please follow the link below: <http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/Choline/Choln02.pdf>)

Traffic light system

Green – Go! These foods contain small quantities of choline

Amber – Go Cautiously. These foods contain moderate amounts of choline

Red - Stop! Eat limited amount of these foods as they contain large amounts of choline

GREEN LIST – GO!

Fruit

All fruits except those listed in the **AMBER LIST** (page 9)

Vegetables

All vegetables except those listed in the **AMBER LIST** (page 9)

Milk and milk products

Creamer	Sour cream
Cottage cheese	Cream cheese
Cheddar cheese	Oat, rice or coconut milk

Fats and Oils

Margarines, butter and vegetable oil spreads (without added lecithin or choline)
Oils: olive, sunflower, canola, corn

Bread, Cereals, Grains, Flours and potatoes

White bread (without added soya flour)	Porridge oats
Plain potato crisps	Sweet potatoes
Danish pastry	Frozen chips
Wheat crackers	Cereals Kraft (honey roasted cereal
Biscuits, plain	Cereals Kellogg's (Cheerios, Wheaties,
Spaghetti noodles	Cornflakes, Rice Krispies)
Brown rice	White rice
Pasta	Wheat flour, white
Bagels	Crumpets
Corn/tortilla chips	Pitta bread
Rice noodles	

Meat, legumes

Pork sausage	Turkey sausage
--------------	----------------

Eggs

Egg whites

Preserves and confectionery

Sugar	Treacle
-------	---------

Icing sugar
Glucose
Jam
Honey
Golden syrup

Chewing gum
Boiled sweets
Lollies and fruit based ice lollies
Marmalade

Beverages and Alcoholic Drinks

Brewed Tea
Fizzy Drinks
Fruit Squash

Mineral Water
Fruit Juice

Limit all alcoholic drinks to small amounts and avoid binge drinking

White wine
Red wine
Spirits

Miscellaneous

Salt
Herbs
Chutney
Soy sauce
Cornflour
Essences e.g. vanilla
Salad dressing (no egg or lecithin E322)

Pepper
Spices
Salsa
Mustard
Vinegar
Baking powder

AMBER LIST - GO CAUTIOUSLY

Fruit

Banana
Melon, cantaloupe

Avocadoes

Vegetables

Cabbage, cooked
Sauerkraut
Broccoli, cooked
Cauliflower
Peas, cooked
Spinach, cooked

Kale, cooked
Yellow corn
Asparagus, cooked
Yellow Squash, Cooked
Brussels Sprouts, cooked

Milk and milk products

Whole milk

Yoghurt plain / fruit

Bread, Cereals, Grains, Flours and potatoes

Oat bran

Wheat bran

Fish and fish products

Fish fingers

Meat, legumes and eggs

Bacon

Peanuts-all types

Canned Beans – navy, kidney, baked

Nuts - Pistachio and cashew nuts are highest

Tofu, soft

Peanut butter

Preserves and confectionery

Chocolate if it contains no lecithin (E322) or choline

Popcorn

Ice-cream if it contains no lecithin or choline

Beverages and Alcoholic Drinks

Coffee – limit to 1-2 cups weak coffee per day

Beer Light (360ml)

RED LIST – USE WITH CAUTION

Milk and milk products

Skimmed milk

Soya milk

Semi-skimmed milk

Sheep and goat's milk

Fats and Oils

Butter spreads and margarine with lecithin or choline added (check ingredients)

Fish and fish products

All other fish incl. shell fish, and fish products e.g. Fish paste, fish pate, fish cakes, fish oils and products containing fish oils. Cod liver oil capsules, Maxepa capsules

Meat, legumes and eggs

Egg

Chicken

Beef, trim-cut

Pork loin

Soyabeans

Mutton

Chicken liver

Beef liver

Ground Beef

Bacon, cooked

Veal

Preserves and confectionery

Chocolate or ice-creams containing choline (1001), lecithin (322) or Soy lecithin (471)

Beverages and Alcoholic Drinks

Milkshakes

Beer, regular (360ml)

Bovril and any drink containing yeast extract

Miscellaneous

Yeast extracts e.g. Marmite, Vegemite,

Table 1: pH value of soaps

Brand name	pH
Avene Ultra-rich soap-free - Cleansing bar - Cleansing gel	5.5
DermaVeen Soap Free wash	5.5
Allergenics - Face and Body shower gel - Skin lotion - Hair shampoo	5.5
Sebamed - Liquid Face - Body wash	5.5
Palmolive Aquarium Hand Wash	5.5
Paula's Choice - All Over Hair and Body Shampoo - Slip Into Silk Body Lotion - Skin Balancing Cleanser - One Step Face Cleanser Normal to Dry Skin - Skin Balancing Moisture Gel - Moisture Boost Hydrating Treatment Cream	6 6 6.3 5.5 6
Neutrogena Extra Gentle Cleanser	5.6-6.2
Dermalogica - The Bar - Dermal Clay Cleanser - Conditioning Body Wash - All face washes	5.5 6.5 4 – 6 4 - 6

*This information is correct at the time of producing this dietsheet

Contact details

Senior Specialist Metabolic Dietitians

Direct line: 0845 155 5000

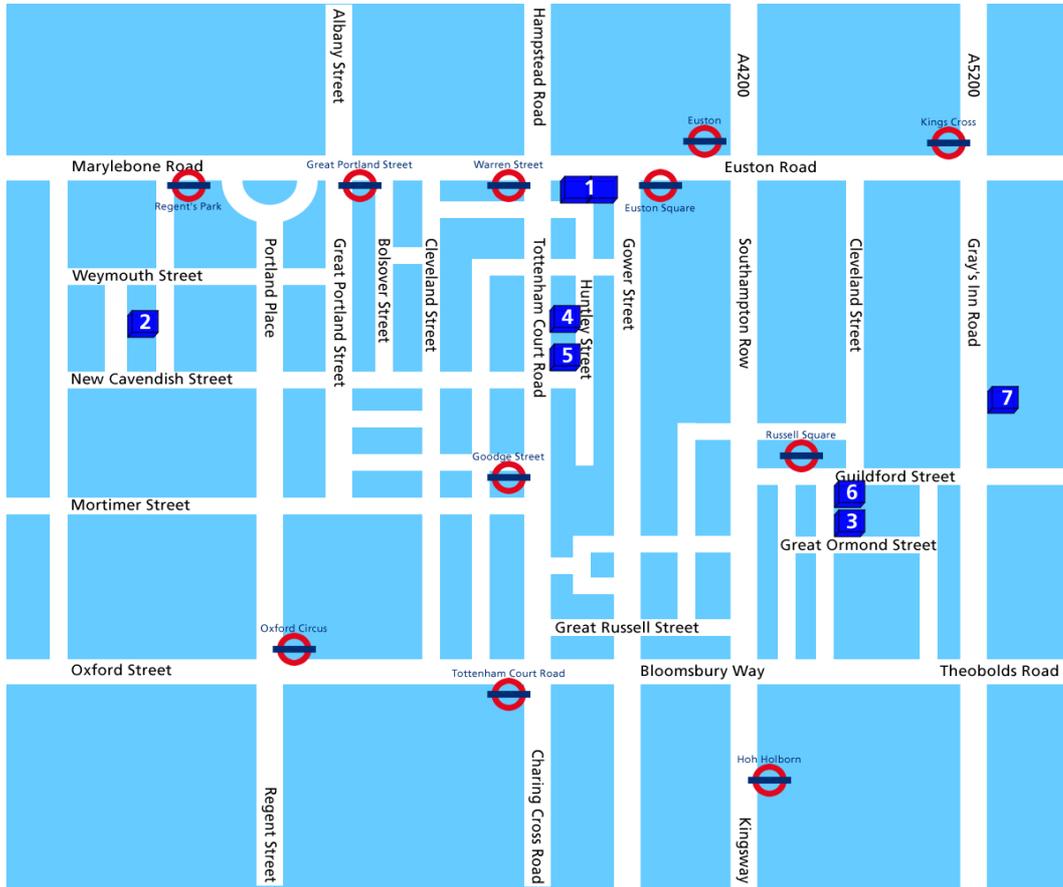
Switchboard: 0845 155 5000

Extension: 83605/ 83604/ 84332

Bleep (pager): 8197/ 8198

Fax: 020 7209 2146

Website: www.uclh.nhs.uk



1 University College Hospital

2 The Heart Hospital

3 Royal London Homoeopathic Hospital

4 Elizabeth Garrett Anderson and Obstetric Hospital

5 Hospital for Tropical Diseases

6 National Hospital for Neurology and Neurosurgery

7 Eastman Dental Hospital

Space for notes and questions

Publication date: August 2010 Date last reviewed:

Date next review due: August 2011 Leaflet code: CONTACT THE PATIENT INFORMATION
CO-ORDINATOR FOR THE CODE FOR THIS LEAFLET –
patient.information@uclh.nhs.uk

© University College London Hospitals NHS Foundation Trust

