Clinical Guideline for the Dietary Management of Paediatric Phenylketonuria (PKU) Clinical Support and Imaging CMG Nutrition and Dietetic Service	University Hospitals of Leicester NHS NHS Trust Trust Reference Number C25/2016

1. Introduction and Who Guideline applies to

These clinical guidelines have been developed to ensure that dietetic advice given to paediatric PKU patients and their families is consistent and follows current scientific evidence and consensus.

The guidelines are intended for use by Senior Specialist Paediatric Dietitians and Senior Paediatric Dietitians within the Nutrition and Dietetic Service, University Hospitals of Leicester NHS Trust. Ideally dietitians using the guidelines should have had relevant clinical training and clinical supervision from the Senior Specialist Dietitian in Inherited Metabolic Disorders.

PKU is an autosomal recessive inherited metabolic disorder of protein metabolism that affects 1 in 12,000 births (Hutchesson et al 1998), with a carrier frequency of 1 in 55 (Loeber, 2007). It is caused by a defect in the gene that codes for phenylalanine hydroxylase (PAH), an enzyme that converts the essential amino acid phenylalanine to tyrosine. This defect causes a build-up of phenylalanine (phe), which if left untreated causes damage to the brain which can result in irreversible intellectual disability, microcephaly, motor deficits, eczematous rash, autism, seizures, developmental delay, psychological and behavioural issues and social difficulties (Targum and Lang 2010 and Brumm et al 2010).

In the United Kingdom infants presenting from newborn screening with blood phenylalanine concentrations consistently ≥ 360µmol/l are treated for PKU. UK infants are screened at day 5 of life and treatment for those affected should commence by day 10 of life.

The management of PKU requires early implementation (by day 10 of life) and continuation of a low phenylalanine diet. This is essentially a very restricted diet, which consists of a limited and controlled amount of protein derived from food sources to provide essential phenylalanine requirements. The diet is supplemented with low protein prescription foods and phenylalanine free amino acid supplements to provide enough protein for growth.

It is recommended that the diet is followed for life. Maintaining adequate adherence to this diet is challenging, but has been shown to be effective in achieving optimal cognitive and psychological development and wellbeing of the child (Van Spronsen and Burgard 2008). Follow up of early treated children with PKU has shown that they broadly fall within the normal range of ability, attain expected educational standards and lead independent lives as adults (Blau et al 2010). Outcome, however is dependent on the quality of blood phenylalanine control (Waisbren et al 2007) and children may have subtle defects in IQ, sustained attention and reaction times, executive function, processing speed, fine motor skills and visual – spatial abilities where levels are poorly controlled (Janzen et al 2010). These changes may be so gradual and subtle that they go unnoticed by the individual for many years or are attributed to causes other than the high phenylalanine concentrations. Family members and those close to the patient may be the first to note the changes. Discontinuation of diet usually results in a self-limited intake and resultant risk of nutritional deficiencies in particular vitamin B12 (Aung et al 1997).

2. Guideline Standards and Procedures

2.1 Aims of Dietetic Treatment

To promote normal growth and development in the PKU child by:

- Restricting phenylalanine intake by restricting natural protein intake.
- Supplementing adequately with phenylalanine-free amino acids (protein substitute).
- Ensuring adequate energy in the diet from non-protein sources (low protein prescription items and "exchange free foods").

2.2 Overview of Dietetic Management

Phenylalanine is an essential amino acid present in all dietary proteins. In order to lower phenylalanine intake in individuals with PKU, it is necessary to substitute the majority of dietary protein with supplements containing a mixture of synthetic amino acids with a similar amino acid profile to dietary protein of high biological value but which exclude phenylalanine. As the diet is very restrictive, these supplements contain a comprehensive range of vitamins, minerals and trace elements.

a) Restrict phenylalanine (phenylalanine) intake

Natural sources of dietary protein are severely restricted in order to achieve optimal phenylalanine control yet meet requirements for this essential amino acid. Phenylalanine is measured using a system of 'exchanges' where 1 'exchange' = 50mg phenylalanine or 1g protein. Phenylalanine tolerance is variable. Children with moderate or severe PKU usually tolerate 150 – 700mg phenylalanine per day (3 – 14 exchanges).

To promote understanding and awareness of the diet a variety of relevant publications from the National Society for Phenylketonuria (NSPKU) are available from the their website www.nspku.org

b) Supplement adequately with phenylalanine-free amino acids (protein substitute)

Protein requirements can only be met by the use of a phenylalanine-free protein substitute (See Appendix 1). The protein substitute will provide at least the Recommended Nutrient Intake (RNI) for protein. However, when amino acids supply most of the protein intake, protein requirements may be greater than the RNI, which is based on diets providing sufficient protein of high biological value and assumes complete digestibility (MacDonald et al 2006).

Table 1 Guidelines for total protein requirements in PKU

AGE (Years)	Total Protein* g/kg
0 – 2	3.0
3 – 5	2.5
6 – 10	2.0
11 – 14	1.5
> 14	1.0 (maximum 80g/day)

* Protein equivalent from protein substitute and phenylalanine exchanges (natural protein)

c) Ensure adequate energy from non-protein sources

Providing adequate energy whilst imposing severe phenylalanine restriction necessitates liberal use of the foods considered to be 'freely allowed', e.g. specific fruit and vegetables and low protein prescription foods. These 'freely allowed' foods contain small amounts of phenylalanine, which can sometimes add significantly to the prescribed phenylalanine intake if taken in excessive amounts. This requires:

- A careful choice of the specially manufactured low protein foods.
- Creative and imaginative use of the fruit and vegetables, which are of lowest phenylalanine content.

- Use of prescribed energy supplements, e.g. Polycal, Super Soluble Duocal, and Calogen as appropriate.

2.3. Dietetic Management of Newly Diagnosed PKU Patients

a) On Diagnosis

- The GP & Health Visitor are informed of diagnosis by one of the Clinical Liaison Nurses (Newborn Screening), from Sheffield Children's Hospital who will then contact the family directly.
- An appointment to meet the Metabolic Team is arranged either the same day or the following day.

b) First meeting with the family

- Record weight and length of the baby.
- Take the current feeding history.
- Discuss the use of the phenylalanine-free infant formula PKU Start (Vitaflo) or PKU Anamix Infant (Nutricia).
- Provide a tin of the phenylalanine-free formula (available from the milk kitchen) and arrange a further tin to be sent directly from the nutrition company via their Metabolic representative ensuring that the family have consented to their details to be passed on and that this is recorded in the notes.
- Instruct the parents about making up the PKU infant formula.
- Advise the parents about an appropriate feeding plan (see information below).
- Request the parents to keep a record of feeds: feed, volume, frequency. (This will aid clinical monitoring).
- Provide a supply of Newborn Screening cards (available from the Clinical Liaison Nurses (Newborn Screening) at Sheffield Children's Hospital).
- Provide the family with the NSPKU folder and provide one of the information booklets on PKU (Temple or Vitaflo). These are all available in the department.
- Give contact details of the Metabolic Team to the parents
- Request an urgent prescription of phenylalanine-free infant formula from the GP via DIT3.
- At the earliest opportunity (ideally the same day), register with Nutricia Homeward for PKU Anamix Infant, or Vitaflo to You for PKU Start, (both companies should be able to arrange delivery of ongoing supplies within 5 working days upon receipt of a prescription from the GP).
- Encourage mum to express breast milk if previously breast feeding and refrigerate and or freeze.
- Contact the Midwife/Health Visitor to arrange further dried blood spots (2 full circles) to be taken in the next 3 days (this may be done by the Metabolic Specialist Nurse by agreement).
- Phone the parents the next day to check any problems/queries and to discuss the timing of dried blood spots. One of the Clinical Liaison Nurse Newborn Screening will arrange to train the family to do their baby's blood spots. (They will provide lancets for the first year and further blood spot cards as needed).

c) Implementation of the diet

Phenylalanine levels greater than 1000 μmol/l:

Stop the natural source of phenylalanine (breast or standard infant formula feed) temporarily replace with the phenylalanine free formula at a minimum volume of 150ml/kg. This should achieve a rapid fall in plasma phenylalanine levels of between 300-600μmol/l/day. When levels are approaching 1000 μmol/l or below then introduce breast or standard formula at 50mg phenylalanine/kg/day as described in the section below, this should be given alongside the phenylalanine free formula. Refer to Appendix 3 for guidance on volume. Encourage mum to express if previously breast-feeding.

Phenylalanine levels 600 - 1000 μmol/l:

i. Formula fed baby;

Normal formula should be restricted to provide around 50mg phenylalanine/kg the volume is dependent on brand (always refer to product nutritional information as this changes from time to time). (Appendix 3).

Phenylalanine free formula can be offered on demand. The total feed volume required should be divided evenly between feeds. The current feeding pattern should remain unchanged if possible, i.e. feed at the times demanded but no more than 8 phenylalanine containing feeds daily (any extra feeds demanded should be phenylalanine free formula). Normal formula should be given first followed by phenylalanine free formula. Minimum total fluid intake should be 150ml/kg/day.

ii. Breast Fed baby;

A measured quantity of phenylalanine free formula (at least 150ml/kg daily) should be given first followed by a breastfeed.

The current feeding pattern should remain unchanged if possible, i.e. feed at the times demanded but no more than 8 phenylalanine containing feeds daily (any extra feeds demanded should be phenylalanine free formula).

Phenylalanine levels 360-600 μmol/l:

Phenylalanine levels should be monitored weekly via a dried blood spot sample to ensure that they are consistently above 360μmol/l before dietary treatment is started. For this group of patients a minimal phenylalanine restriction may be all that is necessary to keep levels within this range. A phenylalanine free infant formula should always be given in conjunction with a dietary restriction.

Phenylalanine levels 120-360μmol/l:

Monitor phenylalanine levels weekly to ensure that levels remain in this range. If levels continue to be within this range then the frequency of monitoring can be relaxed as agreed with the Consultant. Patients with phenylalanine levels consistently within this range do not require a dietary restriction. Frequency of monitoring should always be agreed with the Consultant.

d) Establishing PKU control

Once the phenylalanine is down to around 1000μmol/l normal formula/breast feeds should be reintroduced, to provide 50 mg phenylalanine/kg/day (as for levels below 1000μmol/l – see above).

- Dried blood spots should be done at least twice weekly until control established. These should be taken by the Midwife until the parents feel competent to undertake them. Samples should be posted by first class post to Newborn Screening Laboratory, Sheffield Children's NHS Foundation Trust, Western Bank, Sheffield S10 2TH. Results are reported to the dietitians nhs.net account a day after receipt by the laboratory; however for the first 2 weeks the laboratory can be contacted by telephone for a verbal result.
- Once levels have been established in the desired range repeat once weekly at the beginning of the week.

2.4. Dietetic management of established PKU patients

a) Introduction of Solids

- Solids should be introduced at the usual recommended weaning age, i.e. by 26 weeks but not before 17 weeks for a term baby or 17 weeks corrected for a preterm baby.
- Initially 1-2 teaspoons low phenylalanine foods ('free' foods) should be given e.g. pureed apple/pear/carrot/cauliflower alternatively jars or pouches with protein content of 0.5g/100g or less can be given as 'free foods'.
- Suitable foods should usually be offered after the breast or formula feeds so as not to

inhibit the appetite for the phenylalanine source and protein substitute.

- Once the infant is taking 8 – 12 teaspoons at a time, 50mg phenylalanine exchanges from food are given instead of the equivalent amount of infant formula or breast-feed.
- Exchanges should be introduced one at a time; gradually replacing all breast or formula feeds with equivalent phenylalanine from solid food.
- A second stage substitute should be introduced as the volume of the Anamix Infant formula starts to reduce.

b) Monitoring

- The dried blood spots should be obtained at the same time of the day, preferably a fasting early morning sample as this is when phenylalanine is at its highest (Medical Research Council (MRC) 1993).
- At the Trent Metabolic Network Meeting in September 2017 it was decided that centres in the network would adopt the recommendation for ranges of Phe from the European Guidelines (2017) (Table 2), however the frequency of testing would be set according to the experience of the centres in the network (Table 3).

Table 2 Recommendations for target ranges (European Guidelines (2017))

Age	**Target Range phenylalanine µmol/l**
0 -12 years	120 – 360
12+ years	120 – 600

Table 3 Recommendations for frequency of monitoring (Trent Metabolic Network Sept 2017)

Age	**Frequency of monitoring**
0 - 6 years	weekly
6-12 years	fortnightly*
12+ years	monthly *

**This should be more frequent during illness. Repeat when the patient is well again or when the usual dried blood spot is due, whichever is the sooner.*

c) Reporting Results

Refer to table 2 and 3 for guidance on desired ranges and frequency of testing. Inform the family of the result, preferably by telephone on that day. Some families may prefer email. If this method is preferred ensure written permission has been obtained to exchange emails and that the email is acknowledged. Reporting of results, particularly those in range can be done by the Paediatric Dietetic Assistant on a delegated and supervised basis.

i Elevated blood phenylalanine levels
The dietitian should check the following:

Infants:
- The phenylalanine-free formula is being made correctly if used.
- The phenylalanine–free infant formula is being offered to appetite and is being taken in sufficient volume. (This may be concentrated if necessary)
- Normal infant formula is being made up correctly and given in the advised volume.
- Whether the infant has been ill (see below).

Toddlers and children:
- The protein substitute is being made up correctly.
- All the prescribed volume of protein substitute is being taken and in divided doses (preferably as 3 or 4 doses per day).
- The prescribed numbers of exchanges are being taken each day.
- Labels are being read correctly.
- The protein exchanges are being weighed using digital scales.
- The food weighing scales are working accurately.
- High protein foods are not being taken.
- Low protein products are being correctly prescribed and correct brands consumed (n.b. gluten free products are not necessarily low protein but all low protein products are gluten free).
- Adequate quantities of free food are being given.
- Whether the child has been ill (see below).

During illness:
Infants
- Smaller, more frequent feeds should be offered if vomiting/not completing feeds.
- A lower intake of phenylalanine-containing feeds is acceptable temporarily (as for exchanges for toddlers and children below).

Toddlers and children
- If appetite is reduced the protein substitute should be encouraged above the other components of diet.
- Oral intake should be encouraged little and often, i.e. 2 hourly if vomiting/being refused.
- Glucose polymer may be added to the protein substitute or given as an additional drink if appetite for food is very suppressed < 1yr use 10%,1-2yrs use 15%, 2-10yrs use 20% and >10yrs use 25%. A prescription will need to be requested from the GP.
- If tolerated prescribed Super Soluble Duocal or Calogen-based drinks can be offered
- A reduction in protein exchanges may happen naturally depending on the nature of the illness or should be advised if levels are very high, the protein exchanges can be halved initially if necessary.
- Withdrawal of all phenylalanine exchanges may be advised if high levels persist. This should only last for a maximum of 48 hours and then exchanges should be re-introduced.

If well

Infants

The volume of breast milk or normal infant formula should be **reduced** by 10-30 ml per feed depending on the phenylalanine level and feeding pattern

Toddlers and children

The number of exchanges should be **reduced** (usually ½-1 per day will be sufficient). In practice the number of exchanges should be no less than 3.

ii. Low blood phenylalanine levels
The dietitian should check the following:

Infants:
Normal infant formula feeds are being given in the prescribed volume and frequency.

Toddlers and children
All the prescribed protein exchanges are being consumed.
Exchanges are being weighed.
There is no vomiting.

If well

Infants:
The volume of breast milk or normal infant formula should be **increased** by (10-30 ml) per feed depending on the phenylalanine level and feeding pattern.

Toddlers and children:
The number of exchanges should be **increased** (usually ½ -1 per day will be sufficient).
NB If the drop in phenylalanine has been sudden and unexpected it may be prudent to repeat the sample to check the accuracy.

iii Phenylalanine levels in the target range:
Continue current volume of feeds or number of exchanges.

3. Education and Training

Senior Specialist Paediatric Dietitians/ Senior Paediatric Dietitians with appropriate training ideally having undertaken the British Dietetic Association Masters level Module 4 Dietetic Management of Inherited Metabolic Disorders, Plymouth University.
Ongoing clinical supervision (1:1 and group) should be accessed regularly n.b. contract of employment states x 4 times per rolling 12 months. Dietitians should also ensure that they meet the Health and Care Professional Council (HCPC) standards for continuing professional development (CPD).

4. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Monitoring of nutritional blood annually- more frequently if concerns. To include quantitative plasma amino acids, albumin, full blood count, plasma zinc, selenium, ferritin, folate, vitamin B12, vitamin D	Recorded on clinic proforma	Senior Specialist Paediatric Dietitian Inherited Metabolic Disease	Annually	Clinical notes
Monitoring of weight, height and BMI at each clinic appointment	Patient should have growth chart and the details should be recorded in clinic proforma	Senior Specialist Paediatric Dietitian Inherited Metabolic Disease	Each clinic appointment	Clinical notes
Monitoring of phenylalanine levels from dried blood spots in line with the section 2.4 of this guideline.	Summary from data base recorded on clinic proforma	Senior Specialist Paediatric Dietitian Inherited Metabolic Disease	3 monthly or 6 monthly intervals dependent on age	Levels and frequency are reported to MDT at each clinic appointment

5. Supporting References

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Waisbren SE, Noel K, Fahrbach K, Cella C, Frame D, Dorenbaum A, Levy H Phenylalanine blood levels and clinical outcomes in phenylketonuria: a systematic literature review and meta-analysis. *Mol Genet Metab*, 2007, **92** 63−70.

Useful further reading

Clinical Paediatric Dietetics 5th Ed. Edited by Vanessa Shaw Chapter 28
Metabolic Support UK support network for patients and their carers www.metabolicsupportuk.org (previously CLIMB)
European Society for Phenylketonuria website www.espku.org
National Society for Phenylketonuria www.nspku.org has lots of useful information including the latest dietary information including a list of the current low protein foods available on prescription, which is updated by the NSPKU Dietitian.
Vitaflo www.vitaflo-via.com contains some useful tools for health professionals
Nutricia www.nutricia.co.uk/patients-carers/living-with/low-protein-diet.html contains some useful tools for health professionals

6. Key Words

phenylketonuria, PKU, phenylalanine

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title) Moira French Senior Specialist Paediatric Dietitian	**Executive Lead** Cathy Steele Dietetic Manager
Details of Changes made during review: Section 1 Para 4 All children with levels ≥360µmol/l are treated changed from ≥400µmol/l Para 5 This is essentially a very restricted diet added Section 2 2.1 and 2.2 c minor changes to wording Section 2.3 a & b rewritten Section 2.4 a alternatively jars or pouches with a protein content of 0.5g/100g or less can be given as 'free foods' added Section 2.4 b recently published removed Section 2.4 c if this method is preferred ensure written permission has been obtained to exchange emails added Section 2.4 c (i) Elevated levels (check list) Infants (this may be concentrated as necessary relating to low volume of phenylalanine formula taken) added If well (advise) toddlers and children In practice no fewer than 3 exchanges should be needed Section 4 Monitoring of phenylalanine levels from dried blood spots in line with the section 2.4 of this guideline. Changed to summary from data base recorded on clinic proforma at 3- 6 monthly intervals dependent on age. Section 5 Useful further reading additions: Clinical Paediatric Dietetics 5th Ed. Edited by Vanessa Shaw Chapter 28 Metabolic Support UK (previously CLIMB) Vitaflo www.vitaflo-via.com contains some useful tools for health professionals Nutricia www.nutricia.co.uk/patients-carers/living-with/low-protein-diet.html- contains some useful tools for health professionals Appendices 1& 3 rewritten with the most up to date information	

PROTEIN SUBSTITUTES AND LOW PROTEIN FOOD PRODUCTS

There are a wide variety of protein substitutes and low protein food products available on ACBS prescription. **The range is constantly expanding so it is always advisable to refer to the manufacturer's website or product information within the department for the most up to date information. The two most commonly used companies in UHL are Nutricia Metabolics and Vitaflo International and a list of these supplements is included here. There are other products on the market available to use if the patient is having issues with tolerance/ non compliance. The websites for these are given at the end of the protein substitute section.**

It is sensible to check for changes to product information intermittently, however the companies will usually advise of any changes. Information may also be disseminated via the British Inherited Metabolic Disease Dietitians Group emails if a member.

PROTEIN SUBSTITUTES

NUTRICIA METABOLICS www.nutricia.co.uk

PKU Anamix Infant

Age range: Birth to 1 year and as a supplementary feed up to 3 years.
A powdered infant formula containing essential and non-essential amino acids carbohydrate, fat, vitamins and minerals, supplemented with long chain fatty acids and prebiotic fibres.

70kcal and 2g protein equivalents per 100ml at standard dilution 15%

PKU Anamix First Spoon

Age range: From 6 months to 5 year
A low volume, semi-solid (spoonable), very low phenylalanine, amino acid-based, powdered protein substitute, containing essential and non-essential amino acids, carbohydrate, vitamins, minerals and trace elements, supplemented with the long chain polyunsaturated fatty acids (LCPUFAs).

41kcal and 5g protein equivalents per 12.5g sachet

PKU Anamix Junior

Age range: 1-10 years.
PKU Anamix Junior is a phenylalanine free powder drink mix containing a balanced mixture of the other essential and nonessential amino acids, carbohydrate, fat (including docosahexaenoic acid (DHA)), vitamins, minerals, trace elements and fibre. PKU Anamix Junior is available in neutral, chocolate, orange, berry and vanilla flavours.

135kcal and 10g protein equivalents per 36g sachet

PKU Anamix Junior LQ

Age Range: 1-10 years.
PKU Anamix Junior LQ is a phenylalanine free drink containing a balanced mix of the other essential and non-essential amino acids, carbohydrate, fat, docosahexaenoic acid (DHA), vitamins, minerals and trace elements. Available in orange and berry flavours.

118kcal and 10g protein equivalents per 125ml bottle

PKU Lophlex LQ 10 & PKU Lophlex LQ 20

Age range: 4+
A flavoured phenylalanine free liquid containing a balanced mixture of the other essential and non-essential amino acids, vitamins, trace elements and minerals. Available in two sizes, containing 10g and 20g protein equivalents. Available in berry flavour (10 & 20) and orange (20 only)

58kcal and 10g protein equivalents per 62.5ml pouch

115kcal and 20g per 125ml pouch

PKU Lophlex LQ Juicy 10 & PKU Lophlex LQ Juicy 20

Age range: 4+
A flavoured phenylalanine free liquid containing a balanced mixture of the other essential and non-essential amino acids, vitamins, trace elements and minerals and DHA. Available in two sizes, containing 10g and 20g protein equivalents. Available in juicy orange, juicy citrus, juicy tropical and juicy berries flavours.

60kcal and 10g protein equivalents per 62.5ml pouch

120kcal and 20g per 125ml pouch

PKU Lophlex Sensation 20

Age range: 4years +
A phenylalanine free semi-solid protein substitute containing a balanced mix of the other essential and non-essential amino acids, carbohydrates, vitamins, trace elements, minerals, mixed fruit juices and natural flavourings. Contains DHA. Available in the following flavour: berries.

166kcal and 20g protein equivalents per 109g pot

PKU Lophlex powder PKU

Age Range: 8 years +
A powder free from phenylalanine, but containing a balanced mixture of the other essential and non-essential amino acids, vitamins, trace elements and some minerals. Available in unflavoured, orange and berry flavours. Can be given in a low volume

91kcal and 20g protein equivalents per 27.8g sachet

PKU GMPro

Age Range: 3+ (use with caution in children 3-6yrs)
A low phenylalanine powdered drink containing glycomacropeptide (GMP) with essential and non-essential amino acids, carbohydrates and fat including DHA, vitamins and minerals, trace elements and soluble fibre. Available in vanilla flavour only

128kcal and 10g protein equivalents per 33.3g sachet

PKU GMPro LQ

Age Range: 3+ (use with caution in children 3- 6yrs)
A low phenylalanine ready to use liquid containing glycomacropeptide (GMP) with essential and non-essential amino acids, carbohydrates and fat including docosahexaenoic acid (DHA) and eicocosapentaenoic acid (EPA) vitamins and minerals, trace elements with sugar and sweetener Available in neutral only.

112kcal and 10g protein equivalents per 250ml bottle

VITAFLO https://www.nestlehealthscience.co.uk/vitaflo#

PKU Start

Age range: From birth
PKU start is an amino acid based powdered phenylalanine free* formula containing other essential and non-essential amino acids, carbohydrate, fat, vitamins, minerals, trace elements, arachidonic acid (ARA) and docosahexaenoic acid (DHA).

68kcal and 2g protein equivalents per 100ml at standard dilution of 14%

PKU Squeezie

Age range: 6 months to 10 years
An apple and banana flavoured smooth paste, phenylalanine free substitute containing essential and non-essential amino acids, carbohydrate, sugar, fat, vitamins, minerals, trace elements and long chain polyunsaturated fatty acids (LCPs); arachidonic acid(AHA) and docosahexaenoic acid (DHA)

135kcal and 10g protein equivalents per 85g pouch

PKU explore5 and explore10

Age range: explore5 (6months to 5yrs); explore10 (1year to 5yrs)
A powdered phenylalanine free substitute containing essential and non-essential amino acids, carbohydrate, sugar, fat, vitamins, minerals, trace elements. Arachidonic acid (AHA) and docosahexaenoic acid (DHA)

explore5 (unflavoured) 43kcal and 5g protein equivalents per 12.5g sachet
explore10 (raspberry and orange flavours) 83kcal and 10g protein equivalents per 25g sachet

PKU Cooler

Age range: 3 years +
A range of ready to drink phenylalanine free protein substitutes, available in neutral (white) and flavoured options (orange, purple, yellow and red) containing essential and non-essential amino acids, carbohydrate, vitamins, minerals, trace elements and the Omega-3 long chain polyunsaturated fatty acids (LCPs); docosahexaenoic acid (DHA). Contains sugar and sweeteners.

Cooler 10: 65kcal and 10g protein equivalents per 87ml
Cooler 15: 97kcal and 15g protein equivalents per 130ml
Cooler 20: 130kcal and 20g protein equivalents per 174ml

PKU Express

Age range: 3 years +
A range of powdered phenylalanine free protein substitutes containing essential and non-essential amino acids, carbohydrate, sugar, fat, vitamins, minerals, trace elements. Flavoured options contain sweeteners. Available in unflavoured, orange, lemon and tropical flavours

Express 15: 70kcal and 15g protein equivalents per 25g sachet
Express 20: 95kcal and 20g protein equivalents per 34g sachet

PKU Air

Age range: 3 years +
A range of ready-to-drink, phenylalanine free protein substitutes, containing essential and non-essential amino acids, carbohydrate, vitamins, minerals, trace elements, docosahexaenoic acid (DHA). With sugar and sweeteners. Available in gold (coffee fusion), green (citrus twist), white (caribbean crush) red (berry blast) and yellow (mango breeze).

Air 15: 75kcal and 15g protein equivalents per 130ml pouch
Air 20: 100kcal and 20g protein equivalents per 174ml pouch

PKU Sphere

Age range 4 years +
A powdered, low phenylalanine protein substitute containing a balanced mix of casein glycomacropeptide (GMP) isolate, essential and non-essential amino acids, carbohydrate, fat, vitamins, minerals and docosahexaenoic acid (DHA). With sugars and sweetener. Available in vanilla, red berry and chocolate flavours.
This substitute may need to be introduced gradually owing to the phenylalanine content – one 35g sachet contains 36mg phenylalanine and one 27g sachet contains 28mg phenylalanine. Refer to the guidelines produced by Vitaflo that accompanies the product for further guidance.

PKU Sphere 15: 91kcal and 15g protein equivalents per 27g sachet
PKU Sphere 20: 120kcal and 20g protein equivalents per 35g sachet

Flavour pac

Age range: 1 year +
A range of powdered protein free flavours available in blackcurrant, orange, raspberry and tropical containing carbohydrate, sugar, sweeteners and colouring

12-14 kcal per 4g sachet (dependent on flavour)

The following companies have a small range of GMP or phenylalanine free supplements which are constantly being developed. Please refer to the websites for further up to date information.

FIRST PLAY DIETARY FOODS LTD www.prominpku

CAMBROOKE THERAPEUTICS https://cambrooketherapeutics.co.uk/

MEVALIA https://www.mevalia.com/gb/a/phenylketonuria

APPLIED PHARMA RESEARCH APR https://www.apr.ch/apr-pharma-products/medical-prescription/genetic-metabolic-disease/

FOOD PRODUCTS

There is an ever expanding range of low protein products available on prescription. Key companies include Nutricia www.nutriciahcp.com, Promin www.prominpku.com/first-play-dietary-foods-promin and Mevalia www.mevalia.com/en/products-low-protein/ and Vitaflo www.vitaflo.co.uk, refer to the manufactures website or departmental information for the most up to date product information.

HOME DELIVERY

Home delivery systems for prescription protein substitutes and low protein food products are available for patients' convenience.

Nutricia Homeward is available for Nutricia Metabolic products NB the Nutrition and Dietetic Service, UHL NHS Trust is registered via the Caldicott Guardian to register patients and update the need for products for home delivery.

Vitaflo to You is a new in-house service available for Vitaflo products NB the Nutrition and Dietetic Service, UHL NHS Trust is not registered at this time via the Caldicott Guardian to register patients on this system.

Dialachemist is currently available for Promin and Mevalia products NB the Nutrition and Dietetic Service; UHL NHS Trust is not registered at this time via the Caldicott Guardian to register patients on this system.

These companies provide monthly supplies of product delivered to patient's home address. All requests for products must be supported by a GP FP10 prescription on a 28 cycle.

HINTS FOR TAKING PROTEIN SUBSTITUTE

If the protein substitutes are refused or only partly taken it may result in high phenylalanine levels.

- Always treat protein substitute as a medicine
- Establish a time routine – always give at the same time each day
- Always supervise
- Be firm, but give positive encouragement
- Do not allow excuses
- Be consistent
- If taken with meals, try and give before food to ensure it is taken
- Serve cold straight from the fridge or make up with ice-cold water
- Flavour with strong fruit syrup or try the flavour sachets if unflavoured
- Some people prefer to take liquid protein substitutes through a straw or in a covered cup so they cannot smell them
- Try as a paste from a spoon and wash down with a drink
- Always stir/shake well before and during drinking and do not leave any powders in the bottom (this ensures no vitamins/minerals are left in the bottom of the container)

VOLUME OF WHEY DOMINANT INFANT FORMULA AND BREAST MILK TO PROVIDE 50mg PHENYLALANINE

Milk	Volume required to provide 1 Phe exchange (50mg Phe)
Breast milk	90ml
Cow and Gate First Infant milk (powder)	90ml
Aptamil Profutura Infant milk (powder)	90ml
SMA Pro First Infant milk (powder)	70ml

Correct as of May 2021

Check manufacturers for the most up to date information