

# **Maple Syrup Urine Disease and Pregnancy**

An educational booklet to help  
prepare and plan for your  
pregnancy



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# Introduction

## For women with MSUD, pregnancy and birth may spark many questions.

The wonderful news is that women with MSUD can have safe pregnancies and give birth to healthy children.

This booklet contains basic information, tips, and suggestions to consider before, during, and after pregnancy. Many of the topics included in this booklet were suggested by women with MSUD who have started their own families.

Expecting a child is an exciting time. Our hope is that this booklet will be a useful resource to guide you and other women with MSUD through pregnancy.

### Intent of Booklet

The intent of this booklet is to help women with MSUD plan and prepare for pregnancy. The information presented in this booklet may help you start conversations with your metabolic team. The booklet is **not** meant to replace the medical and nutrition advice from your metabolic team.

**Always ask your metabolic team if you have any questions or concerns about MSUD and your pregnancy.**



# Understanding Maple Syrup Urine Disease

## What is Maple Syrup Urine Disease (MSUD)?



**MSUD is a genetic disease that affects your body's natural ability to break down protein.**

- Our bodies need 20 different building blocks to make protein. These building blocks are called “amino acids.” They play an important role in building muscles, bones and other organs.
- MSUD affects how your body breaks down 3 of these amino acids: leucine, isoleucine, and valine. These amino acids are known as the “branched-chain amino acids.”
- Leucine, isoleucine, and valine are found in all protein foods, but are especially high in foods such as eggs, dairy, and meat.



Leucine, isoleucine, and valine are normally broken down by the body. Here are some examples of when this happens:

- **When we eat more of these amino acids than we need.**
- **When we do not eat enough calories.** These amino acids can be released from tissues in our body to produce energy.
- **When we experience stress during illness, injury, or surgery.** In response to stress, our muscles can break down and release these amino acids.

Because you have MSUD, your body has a more difficult time breaking down leucine, isoleucine, and valine, so levels of these amino acids can increase in your blood. Very high levels can have harmful effects on your health.

It is important to keep your levels within the ranges recommended by your metabolic team. This can be done by:



**Limit your intake of “natural” protein.** Natural protein is protein that is found in foods and beverages. To learn more about “natural” protein, please see page 12.



**Drink your MSUD formula.** MSUD formulas are designed to help meet your protein goals without increasing your blood levels of leucine, isoleucine, and valine. To learn more about “formula” protein, please see page 13.



**Make sure you eat enough calories.** Your MSUD formula has both carbohydrate and fat to provide calories. Foods that are higher in calories, but contain little protein, can also help you meet your goals.



**Routinely check your blood levels.** Measuring your leucine, isoleucine, and valine levels will help you and your metabolic team decide if your current treatment needs to be changed.



**Recognize when you are not feeling well.** Make sure you and your metabolic team has a plan for mild illnesses and for more serious situations, such as a metabolic crisis.

With MSUD, your blood levels of leucine, isoleucine, and valine can all increase. **However, your leucine levels are the most important.** Leucine is the amino acid that can be the most harmful to your health. Very high leucine levels can cause a metabolic crisis.

## What is a metabolic crisis or an “episode”?



Very high leucine levels can lead to a metabolic crisis or an “episode.”

**Because high leucine levels can be dangerous to your health and wellbeing, it is important for you and your loved ones to recognize the signs and symptoms of a metabolic crisis:**

- You feel unusually lethargic and tired.
- You feel “dizzy” or have trouble staying awake.
- Your thoughts may seem unclear or “fuzzy.”
- You have a poor appetite or are experiencing nausea and vomiting.



**Work with your metabolic team to make sure you and your loved ones have a plan in place if you begin to experience the signs and symptoms of a metabolic crisis.**

# MSUD and Pregnancy

## Are women with MSUD able to have children?

**YES!** With newborn screening, early intervention, diet treatment and medical care, children who are born with MSUD are able to grow and develop normally. More and more individuals with MSUD are reaching an age where they might consider starting their own family.



**Today, many women with MSUD around the world have had successful pregnancies and are now mothers to healthy children.**

## How will my MSUD affect my pregnancy?

Your leucine level may increase during your pregnancy for different reasons, such as:



**Morning sickness during the 1<sup>st</sup> trimester of pregnancy.** This can place your body under stress, which may increase your leucine level.



**The boost in calorie and protein requirements during the 2<sup>nd</sup> and 3<sup>rd</sup> trimester of pregnancy.** This means you may need to eat more natural protein or drink more formula than usual to help keep your leucine level within a goal range.



**Labor and delivery.** Whether it is a vaginal birth or a C-section, your body will be under a lot of stress, which can increase your leucine level.



**“Undoing” the changes that happened to your body during pregnancy.** After delivery, your body will begin to return to its pre-pregnancy state. This may involve breaking down tissue that is no longer needed, which can increase your leucine level.

## Will my leucine level affect my baby?



Based on women who have had successful pregnancies, high leucine levels during pregnancy may not directly affect a baby's short-term health. However, we do not know for sure if high leucine levels during pregnancy can affect a baby's long-term health and development.

**Your health and your baby's health are both important.** Keeping your leucine levels within the recommended range helps you stay well and supports a safe pregnancy and birth.

## Will my baby have MSUD?

**Your diagnosis does not mean your baby will have MSUD.**

MSUD is a genetic disorder that can only be inherited if both parents have the "MSUD gene."

**The chances of your baby having MSUD depends on whether your partner also has a gene for MSUD.**

- Most people do not have the MSUD gene. Some people have one MSUD gene, but do not know it.
- Your baby would need to inherit two MSUD genes, one from you and one from your partner. **If your partner does not have the MSUD gene, your baby will not have MSUD.**
- In most communities, MSUD is very rare. If you and your partner are concerned, you can choose to do genetic testing. This test can tell you the probability of your baby having MSUD.

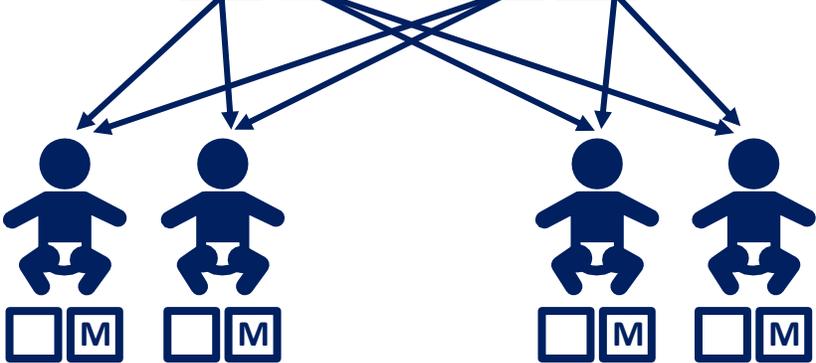


# How is MSUD inherited?

Father who does not have MSUD or the MSUD gene



Mother who has MSUD and two MSUD genes

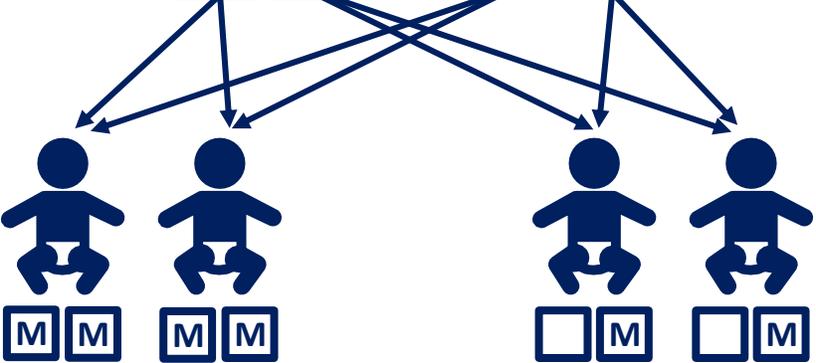


Their child will not have MSUD, but they will have one MSUD gene.

Father who does not have MSUD, but has one MSUD gene



Mother who has MSUD and two MSUD genes



There is a 50% chance that their child will have MSUD.

If you have questions about how the MSUD gene can be passed down from a mother or father to their children, ask to talk with a genetic counselor in your clinic.

# Before Your Pregnancy

## Planning Your Pregnancy



If you are interested in starting a family, it is important to begin a conversation with your metabolic team.

**Before this conversation, think about how you would answer these questions:**

- Do you feel comfortable and confident with how you currently manage your MSUD?
- What do your leucine, valine and isoleucine levels usually look like?
- Is it challenging for you to keep your levels within a goal range? If so, are you able to identify what makes it challenging for you?
- Will you be able to send labs more frequently, such as once per week?
- Do you feel you have a strong support system to help you through your pregnancy?

**By discussing these questions with your metabolic team, you can work together to address any concerns and prepare for a safe pregnancy.**



## Helpful Tips



**Make sure you and your metabolic team develop a “sick day” plan and a plan if you are experiencing a metabolic crisis.**



**Keep your Emergency Protocol with you if you need to go to the Emergency Room.**



**Keep your metabolic team’s contact information readily available.**



**Start a journal or log of your blood levels.** This can help you track your levels, especially when you begin checking your labs more frequently.



**Plan to track your food intake.**

A food diary can help you keep track of how much formula you are drinking, what you are eating and how much natural protein or leucine you are consuming. You can keep a journal or use web-based applications, such as “MyFitnessPal”, to record what you eat and drink.

## What is natural protein, and why is it important?

**“Natural protein” is the protein you get from foods and beverages.**

- Natural protein sources are “intact.” In the body, protein is broken down into its individual amino acids.
- Protein in foods and beverages have different amounts of amino acids, including leucine, isoleucine, and valine. Eating too much natural protein can mean eating too much leucine, which can increase your blood levels.



### **Natural proteins are an important part of your diet!**

- While it may be harder for your body to break down leucine, isoleucine, and valine, it is still important to include limited amounts of these amino acids in your diet.
- Remember, leucine, isoleucine, and valine help build tissue in your body during pregnancy. Plus, they are necessary for your baby to develop and grow!

**The key is to eat enough leucine, isoleucine, and valine from natural protein sources to meet your and your baby’s protein needs while keeping your blood levels within a healthy range.**



Based on your levels, your metabolic team will help you set a goal for your natural protein and leucine intake.

Expect your natural protein and leucine intake to change during pregnancy as both your and your baby’s needs change.

## What is formula protein, and why is it important?

**“Formula protein” is the protein you get from your formula.**

- Formula protein is not “intact.” Formula provides all the amino acids you need **except** leucine, isoleucine, and valine.
- Your body uses these other amino acids to build new muscle and other tissues.



By providing amino acids that your body can easily use, formula helps you meet your protein needs without increasing your leucine, valine and isoleucine levels.

**Formula can also be a good source of other nutrients, including carbohydrate and fat.**

- Carbohydrate and fat provide calories that are used by the body for energy.
- Foods like milk, cheese, meat, eggs, beans, and nuts, have important nutrients and energy to support health. However, these foods are very high in protein.



Because you need to limit these foods in your diet, it may be challenging to meet all your nutrient and energy needs. Formula helps fill these gaps.

## Counting Protein or Leucine

Some people with MSUD learn to count leucine in their diet, others learn to count protein. Discuss which method is best for you with your metabolic team.

**Counting protein or leucine helps you meet your and your baby's needs for leucine, isoleucine, and valine.** Counting also helps you avoid eating too much leucine or protein so that your blood levels of these amino acids remain in the goal range.

### Why do I only need to count leucine?

- Foods contain much less valine and isoleucine than leucine.
- If you are eating foods to meet your goal for leucine, you will not be eating too much valine or isoleucine!

### Ideas for Counting Protein or Leucine



**Use food lists.** Food lists provide information about the grams of protein and milligrams of leucine in a specific serving size. A food list can be found at the end of this booklet. Online and print resources are also included.



**Measure your foods.** Measuring your food can help you count your protein or leucine more accurately. You can use measuring spoons and cups. A gram scale will give you the most accurate count.



**Record how much protein or leucine is in your food.** This will help you keep track of how much protein or leucine you are eating so you meet your goal each day.

# A Helpful Counting Tool: Estimating Leucine Content

- Sometimes, food lists may not have the food you are looking for.
- You can estimate the amount of leucine based on the grams of protein in that food.



Food Groups	Leucine Content
Breads, Cereals, and Grains	70 mg of leucine <b>PER 1 gram of protein</b>
Vegetables	50 mg of leucine <b>PER 1 gram of protein</b>
Fruit	40 mg of leucine <b>PER 1 gram of protein</b>
Mixed Foods*	60 mg of leucine <b>PER 1 gram of protein</b>

\*Mixed foods refer to foods that use different food groups, such as chili or fried rice.

## Let's practice using a nutrition label for whole wheat bread.

Nutrition Facts	
20 servings per container	
<b>1</b> Serving size	1 slice (34g)
Amount per serving	
<b>Calories</b>	<b>90</b>
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 140mg	6%
Total Carbohydrate 15g	5%
Dietary Fiber 2g	7%
Total Sugars 1g	
Includes 1g Added Sugars	2%
<b>2</b> Protein 6g	5%
Vitamin D 0mcg	0%
Calcium 8mg	0%
Iron 1mg	6%
Potassium 59mg	2%
Phosphorus 71mg	6%

\*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

1. First, look at the serving size. This label tells you that the serving size is 1 slice of bread.
2. Then, look at the amount of protein. Here, 1 slice of bread contains 6 grams of protein.
3. Multiply the number of servings you eat by the amount of protein per serving. This will tell you the total amount of protein you eat. For example, if you eat 2 slices of bread:
 

**2 servings x 6 grams of protein = 12 grams of protein**
4. To figure out how much leucine is in the bread, Multiply the total grams of protein by the amount of leucine found in 1 gram of protein in that food group.
5. Because whole wheat bread is in the “Breads, Cereals, and Grains” food group, you would multiply 12 grams of protein by 70 milligrams of leucine:

**12 grams of protein x 70 mg of leucine = 840 mg of leucine**



## Valine and Isoleucine Supplements

**While your leucine levels are of most concern, it is still important to keep valine and isoleucine levels in a safe range.**

Because your intake of leucine from natural protein is very limited, you may not get enough valine and isoleucine from the foods you eat. Deficiencies can affect your skin, eyes, hair, and gut and may affect your baby's growth



If your valine and isoleucine levels are below your goal range, your metabolic team may prescribe valine and isoleucine supplements to add to your formula.



When you need to restrict your leucine intake during times of stress, injury, illness, or a metabolic crisis, you may need to take even more valine and isoleucine supplements.

## Vitamins and Minerals

Most MSUD formulas include vitamins and minerals.

Vitamins and minerals play an important role in supporting your pregnancy and baby's growth. The table below includes several examples.



<b>Vitamin or Mineral</b>	<b>Why is this vitamin/mineral important?</b>
<b>Iron</b>	Iron keeps your red blood cells healthy. Red blood cells help transport oxygen to your tissues, including the placenta and your baby.
<b>Folate or Folic Acid</b>	Folate supports your baby's brain and spinal cord development, especially in early pregnancy.
<b>Calcium</b>	Calcium supports the strength of your bones. It helps your baby build strong bones, too.
<b>Vitamin D</b>	Vitamin D works with calcium to support your baby's bone development. Vitamin D also supports your immune system, protecting you from getting sick.
<b>Zinc</b>	Zinc supports your baby's overall growth. Zinc also plays an important role in supporting your immune system.
<b>B vitamins, like thiamin, riboflavin, niacin, B<sub>6</sub>, B<sub>12</sub></b>	Many B vitamins help your body use carbohydrates, fat, and protein to make energy. This energy can be used to help support your pregnancy and baby.
<b>Vitamin A</b>	Vitamin A is important for your baby's growth and development. It can also support the immune system and eye health.

## Do I need a vitamin and mineral supplement?

**During pregnancy, your requirements for some vitamins and minerals will increase.**



To make sure you are meeting your vitamin and mineral needs, your metabolic team will evaluate how much of the different vitamins and minerals are found in your formula and foods you eat. They may also check your levels of different vitamins and minerals in your blood.

This helps your metabolic team decide if you need to take a prenatal supplement. Prenatal supplements provide a variety of vitamins and minerals. **As an example, a prenatal supplement may provide:**

- 27 mg of iron
- 800 mcg of folic acid
- 4 mcg of vitamin B<sub>12</sub>
- 25 mg zinc
- 150 mcg of calcium
- 400 IU of vitamin D
- 770 mcg of vitamin A



### **There are many different prenatal supplements on the market.**

- Different brands contain different amounts of vitamins and minerals.
- Prenatal supplements may also provide other nutrients, like EPA and DHA. These are omega-3 fatty acids, which are important for your baby's brain and eye development.
- If your metabolic team recommends a prenatal supplement, work together to pick the best option for you.

## Staying Healthy and Well

During your pregnancy, your leucine level can increase if you become ill. Here are some ideas to help you stay well:



### Wash Your Hands Frequently

The germs on your hands can make you sick, especially if you touch your eyes, mouth, or nose.



### Practice Good Oral Hygiene

Keep your teeth and gums healthy to prevent tooth and gum disease. These problems can cause infections in other parts of your body.



You may want to see your dentist before your pregnancy to make sure you do not have any existing problems.



### Practice Food Safety

Wash fresh fruits and vegetable with water to get rid of germs that can make you sick.



Prepare meals on a clean surface to stop germs from transferring to your food.



Make sure foods and beverages are stored properly. If a food or beverage has gone bad, it is safer to throw it out.

## Sick Day Plan



**You and your metabolic team should develop a plan for any illness. If you do get sick, know how to reach your metabolic clinic for directions. Make sure your Emergency Protocol is up-to-date in case you do need to go to the Emergency Room.**

**For milder illnesses, you may be directed to start a “sick diet.” This plan will be designed to meet your needs, but goals may include:**

- Eat less protein and drink more formula to help reduce your leucine level.
- Meet your energy needs by eating more low-protein medical foods, like low-protein bread or pasta.
- Stay hydrated by drinking enough fluids.
- Pay close attention to how you are feeling and maintain frequent contact with your clinic.



**If your illness becomes more severe or you feel more symptoms of a metabolic crisis, it is important that you receive medical attention as soon as possible.**



# What to Expect: Your 1<sup>st</sup> Trimester

## Conception to month 3 of pregnancy

Early in pregnancy, changes in hormones help prepare your body for a baby. These hormonal changes affect almost every organ system, like your heart, small and large intestines, muscles, and bones.

### In the 1<sup>st</sup> trimester, you may notice and feel some of these changes:

- Tender, swollen breasts
- Needing to urinate more frequently
- Feeling more tired than usual
- Nausea, with or without vomiting, or “morning sickness”
- Cramping in your lower belly
- Food aversions, meaning some foods make you feel sick
- Food cravings



### For your baby, some of the most important and exciting developments happen in the 1<sup>st</sup> trimester.

- In the first 4 to 5 weeks, your baby’s brain and heart start to form.
- At 8 weeks, other organs and body structures are developing. Fingers and toes are forming as your baby’s arms and legs grow longer.
- By the end of the 1<sup>st</sup> trimester, your baby’s nerves and muscles start to work together. Your baby’s sex organs have developed, although you might not be able to find out if it is a boy or girl until later in your pregnancy.

## Helpful Tips



During this time, it is important to check your blood levels weekly or as often as your metabolic team recommends.

### What are the goals for my blood levels?

During pregnancy, goals for blood levels of leucine, valine and isoleucine may change. Your clinic will establish these goals for you, but they are often like these:

#### Goals for Leucine, Isoleucine, and Valine Levels

<b>Leucine</b>	100 to 300 umol/L	1.3 to 3.9 mg/dl
<b>Isoleucine</b>	200 to 400 umol/L	2.6 to 5.2 mg/dl
<b>Valine</b>	200 to 400 umol/L	2.3 to 4.7 mg/dl

Source: Genetic Metabolic Dietitians International MSUD Guidelines, 2013

### Why do I need to check my levels so often?

- As your body begins to change during pregnancy, energy and protein needs will increase to support you and your growing baby.
- Checking blood levels frequently can help your team decide if you need to make any changes to your MSUD diet.

## Protein and Energy Needs in the 1<sup>st</sup> Trimester

In the 1<sup>st</sup> trimester of pregnancy, your needs for protein, leucine and energy will not increase very much. Some women may be able to continue their usual MSUD diet in the 1<sup>st</sup> trimester. Others may need to make some small diet changes. Work with your metabolic team to decide if diet changes need to be made at this point in your pregnancy.

## Weight Gain During Pregnancy

While your weight may not change very much in the 1<sup>st</sup> trimester, during pregnancy, weight gain is encouraged!

- Weight gain is a sign that your body is making important changes to support your pregnancy and your baby's growth and development.
- Throughout pregnancy, your team will monitor your weight to make sure you are gaining an amount of weight that is healthy for you.



**Pregnancy is not a time for weight loss. For women with MSUD, not eating enough calories can increase their risk for having a metabolic crisis.**

## Managing Morning Sickness

During the 1<sup>st</sup> trimester, many women experience some “morning sickness,” but it can happen at any time of the day.



- Morning sickness, especially with vomiting, can be concerning for women with MSUD.
- Nausea and vomiting can make it difficult to drink your formula and eat enough calories and protein. This can place your body under stress. Without addressing these concerns, morning sickness can increase your leucine levels and may cause symptoms of a metabolic crisis.

**To manage morning sickness, here are some strategies you can try at home:**



Eat before or as soon as you feel hungry. An empty stomach can worsen your nausea. Some women feel their symptoms improve if they eat something like saltine crackers right when they wake up.



Space out meals and snacks to avoid eating too much at one time.



Drink your formula and other beverages in between your meals and snacks.



Avoid foods that may upset your stomach, like spicy or oily foods.



Take your prenatal vitamin later in the day instead of first thing in the morning.



## Avoid “triggers” that make your morning sickness worse.

- Eat meals and snacks next to an open window if the room feels stuffy or if your food has a strong smell.
- Loud noises and flickering lights can be a trigger for nausea and vomiting. Try to enjoy your meals in a quiet, calm, and relaxing environment.
- Motion can also worsen symptoms. For example, try to avoid eating while in the car. Avoid changing positions too quickly after eating, like laying down right after a meal.
- Brush your teeth after eating to reduce the “bad taste” in your mouth.

**Morning sickness can be very frustrating and difficult to manage.** Let your metabolic team know if you have morning sickness. Your team may prescribe medication to help manage your morning sickness. For many women, morning sickness improves – or even goes away – by the 2<sup>nd</sup> trimester.

# What to Expect: Your 2<sup>nd</sup> Trimester

## Months 4 to 6 of pregnancy

The 2<sup>nd</sup> trimester is an exciting time! During this time, your body continues to change and starts to make room for your growing baby. Many women begin to “show” in their 2<sup>nd</sup> trimester.

### In the 2<sup>nd</sup> trimester, you may notice some new changes:

- Your belly starts to expand
- Your weight will increase more quickly
- Your back, belly, and thighs may ache

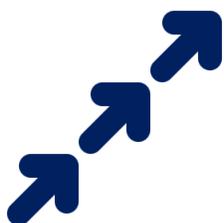


### In the 2<sup>nd</sup> trimester, your baby grows and develops -fast! Before the trimester ends, you may feel your baby beginning to move.

- At 16 weeks, your baby’s muscles and bones create a more complete skeleton, and skin starts to form. Your baby is also able to make sucking motions.
- At 20 weeks, your baby is more active, and you may feel slight movements. Your baby can hear and swallow!
- By the end of the 2<sup>nd</sup> trimester, your baby is growing hair, can sleep and wake regularly, and has a footprint and fingerprints. Your baby is now storing fat and gaining more weight.

## Helpful Tips

### Protein and Energy Needs in the 2<sup>nd</sup> Trimester



During the 2<sup>nd</sup> trimester, your body needs more protein, leucine, and energy to support your pregnancy and your baby's growth. Your baby also starts to break down amino acids.

Because of this, you may begin to “tolerate” more natural protein and leucine in your diet. This means that you may be able to eat more natural protein and leucine while your leucine level stays in a safe range.

**Checking your levels often will help your team know when you need to add more protein, leucine, and energy to your diet.**

- **Your team will recommend changes to your MSUD diet based on your blood levels.** These recommendations will be different for each person. During the 2<sup>nd</sup> trimester, some women might need to double the amount of natural protein and leucine they eat!
- **Let your team know if you have any questions or concerns about their recommendations.** Your team will work with you to make sure you feel confident making changes in your diet.



## Meeting Your Protein, Leucine, and Energy Needs

It might take time to get used to eating more protein and energy. To help meet your new goals, you will likely need to make changes to your MSUD diet. These changes could include:



**Increase how much formula you drink.** It may be helpful to space out how much you drink throughout the day.



**Adjust your formula.** If the volume of formula that you need to drink is too much, let your team know. There may be ways to change your formula so that it has more calories and protein in a smaller volume.



**Replace low protein pastas and baked goods with regular grain products.**



**Add snacks with protein throughout your day.** Snacks like granola bars are easy to carry around and provide calories and protein.



**Add foods and beverages with more protein into your meals.** For example, add skim milk powder to your formula or add cheese to some foods. See pages 61 to 73 for the protein content of different foods.



**Boost the calories in your meals by adding or mixing in foods that contain extra calories, but little protein.** For example, add extra margarine on a sandwich or extra syrup on pancakes. See pages 45 to 47 for more ideas.

**Making changes to your MSUD diet can be fun and exciting!** Some women with MSUD who have had successful pregnancies said they enjoyed eating the same meals as their family and tasting foods they have always been curious about.

# What to Expect: Your 3<sup>rd</sup> Trimester

## Months 7 to 9 of pregnancy

The 3<sup>rd</sup> trimester marks the last few of months of your pregnancy! During this time, your baby grows quickly. This can put some pressure on your organs and cause additional changes to your body.

### In the 3<sup>rd</sup> trimester, some new changes might include:

- Shortness of breath
- The feeling of your baby “dropping” or moving lower in your belly

**The 3<sup>rd</sup> trimester is also an exciting time for your baby. During this time, your baby will continue to grow and develop as his body prepares to function on his own!**



- At 32 weeks, your baby’s movements may be more forceful! His bones are fully formed, and his body starts to store important nutrients, like iron. At this point, your baby is gaining weight quickly- about ½ pound (about 230 grams or 0.23 kg) a week.
- At 36 weeks, your baby’s body starts to store more fat. As your baby gets bigger, he has less space to move around. While his movements might feel less forceful, you may still feel stretches and wiggles.
- At 39 weeks, your baby’s organs are ready to function on their own!

## Helpful Tips

### Protein and Energy Needs in the 3<sup>rd</sup> Trimester



In the 3<sup>rd</sup> trimester, you may need even more protein, leucine, and energy to support your pregnancy and your baby's growth.

Because of this, you may be able to eat even more natural protein and leucine without your blood levels increasing above your goal range.

**It is still important to check your blood levels often because your protein, leucine, and energy needs continue to change during the 3<sup>rd</sup> trimester of pregnancy.**

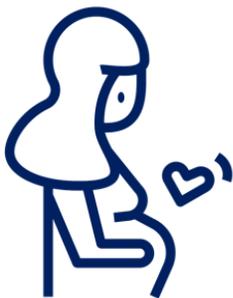


By the end of the 3<sup>rd</sup> trimester, some women may need to triple or quadruple their natural protein and leucine intake!

**The ideas for meeting your needs during the 2<sup>nd</sup> trimester can be helpful in the 3<sup>rd</sup> trimester as well. You can review these ideas on page 25.**



Because your energy and protein needs are higher in the 3<sup>rd</sup> trimester, you may need to make even more changes throughout the day or increase the amount you eat or drink in each meal and snack.



Women who have had successful pregnancies have mentioned feeling motivated to meet their needs because they knew it would support their baby's growth.

They also felt that the 3<sup>rd</sup> trimester was "easier" since they were more comfortable with the changes they already made to their diet and daily routine.

**If you are having a difficult time and are experiencing stress with your MSUD diet, share your concerns with your team. Your team can give you additional ideas, suggestions, and support.**



# What to Expect: Labor and Delivery

**To help make sure you give birth to your baby safely, it is important that you, your metabolic team, and your labor and delivery team develop a plan.**



It can be helpful to start these conversations with your team early in your pregnancy and revisit any established plans as you get closer to your due date.

**As you and your metabolic team discuss plans for labor and delivery, here are some important thoughts to consider:**



**Some women have been able to have vaginal births while others have had C-sections.** Both delivery methods have resulted in successful births to healthy babies.



**No matter the method, labor and delivering a baby will put your body under a lot of stress. Your leucine levels can rise quickly.** You may be started on IV nutrition to make sure you continue to get enough energy during labor. This can help keep your leucine level in a safe range.

# What to Expect: After Your Pregnancy



**The time after you give birth to your baby is known as the “postpartum period.” During this time, your body begins to return to the way it was before your pregnancy.**

“Undoing” changes to your body during pregnancy happens slowly over time. While the first 6 to 8 weeks after delivery is usually considered the postpartum period, it can take up to 12 months or longer before your body is back to its pre-pregnancy state.



**Your leucine level may be higher than your goal range after you deliver your baby.**

As your body begins to undo the changes that happened to your body during pregnancy, it will start to break down any tissue it no longer needs. This can make your leucine levels higher than normal.

For example, you might hear about “uterine involution.” This is when the uterus starts to return to its usual size. This process begins right after delivery, and for women with MSUD, it can increase their leucine levels.

## Helpful Tips

### Protein and Energy Needs in the Postpartum Period

Right after delivery and during the postpartum period, your protein and energy needs will change.



To help keep your leucine level in a safe range after you give birth, your team will continue to make sure you get enough energy after delivery. This may initially be provided through IV nutrition.



Because women with MSUD may be at risk for a metabolic crisis after delivery, you may need to restrict how much natural protein or leucine you eat. Due to the amount of tissue breakdown after delivery, a “sick day” diet may be recommended.



Your team may recommend slowly re-introducing natural protein or leucine back into your diet. You may need to increase natural protein intake in “steps” over time. For example, you might start with 5 grams of natural protein for one week, then 10 grams the next week, until you meet your needs.

### Your protein and energy needs will also depend on whether you choose to breastfeed.

- Breastfeeding increases your protein, leucine, and energy needs. If you breastfeed, your diet goals may be similar to your goals during the 3<sup>rd</sup> trimester.
- If you do not breastfeed, your protein, leucine, and energy needs may be more like your goals before you were pregnant.

**Remember, your body may need time to undo any changes that happened during pregnancy.**

Some women noticed that their leucine levels didn't decrease back to the goal range, even after they returned to their pre-pregnancy MSUD diet. If this happens to you, it may take some time and patience, but your metabolic team will work with you to help you meet your goals.

## Checking Your Levels in the Postpartum Period

**Because your protein and energy needs will change after your pregnancy, it is important to check your blood levels often.**



After you go home with your new baby, your team may recommend checking your levels as often as once a week. Let your team know if you have any concerns about how often you can check your levels.

## What are the goals for blood levels after pregnancy?

Your goals for leucine, isoleucine, and valine will likely be the same as they were before your pregnancy. Your clinic will establish these goals for you, but they are often like these:

### Goals for Leucine, Isoleucine, and Valine Levels

<b>Leucine</b>	75 to 300 umol/L	1.0 to 3.9 mg/dL
<b>Isoleucine</b>	200 to 400 umol/L	2.6 to 5.2 mg/dL
<b>Valine</b>	200 to 400 umol/L	2.3 to 4.7 mg/dL

Source: Genetic Metabolic Dietitians International MSUD Guidelines, 2013

# Other Considerations

## Will I be able to breastfeed my baby?



**Women with MSUD have been able to breastfeed their baby while managing their MSUD.**

Let your team know if you are interested in breastfeeding before or at any point during your pregnancy. This can help you and your team plan ahead for your protein and energy needs after your pregnancy.

**It can be challenging to balance caring for your baby and managing your MSUD. Infant formula can be a good option.**

- Many families rely on feeding infant formula to their baby for a variety of reasons, whether MSUD is involved or not.
- Infant formula is designed to be similar to breastmilk. It will provide your baby with the nutrients he needs.
- If you choose to use infant formula exclusively or in combination with breastfeeding, your baby can still grow and develop normally!



**The most important thing is that you are giving your baby the nutrition he will need while caring for yourself.**

Some women may feel pressured to breastfeed their baby or feel guilty when they use infant formula. Please remember that your health and wellbeing are important, too.

**“Staying healthy helped me take care of my baby.”**

**– Thoughts from a Mom with MSUD**

## Weight Loss After Pregnancy



After giving birth, some women will slowly return to their pre-pregnancy weight. Others may have difficulty losing the weight they gained during pregnancy.

**If you have goals for weight loss, work with your metabolic team to discuss ideas and strategies.**



Your team can help you safely meet your weight goal. Losing weight too quickly may cause your leucine level to increase. Healthy weight loss will take time, especially as you are also taking steps to manage your MSUD in the postpartum period.

## Coping During the Postpartum Period

Having a new baby can be an exciting and joyful experience. At the same time, a new baby can bring big changes to your daily routine.



Being a new parent can feel overwhelming. New challenges can make it harder to take care of yourself, follow your MSUD diet and keep your levels in a safe range.



**During these times, it is OK to ask for help.** Before you go home with your baby, it can be helpful to talk with your team about your concerns. Your team can connect you to resources that can help manage the stress of being a new parent.

**If you would like to be connected to other moms with MSUD, the MSUD Family Support Group can help.**

Knowing that you are not alone in your experiences can bring a sense of comfort and relief. The MSUD Family Support Group can help connect you to other moms with MSUD. You can access their website at <https://www.msud-support.org/>.



## You can also take steps at home to help manage stress:



Recognize that it is natural to feel stressed after you have your baby, and know that you are not alone in feeling this way.



Try to get as much rest as you can, like taking naps when your baby sleeps, or nap during a car ride!



If possible, take some time for yourself to do things you enjoy while your partner or a loved one looks after your baby. Take this time to go for a walk, read a book, or catch up with a good friend.



Try to relax your standards for household chores. If you don't get to the laundry like you planned, that is OK.



Be open to accepting help from loved ones. Let them take some tasks off your “to-do” list so you can focus on caring for yourself and your baby.

Source: March of Dimes, 2013

# Additional Resources



# Monitoring Your Pregnancy



**In addition to checking your leucine levels and adjusting your diet, your team may also monitor your pregnancy in other ways.**

Below are some examples of what your team might ask about or measure during your pregnancy. However, when and how often this happens will depend on your clinic and where you are in your pregnancy.

## Before Your Pregnancy

	<b>When and how often is this checked?</b>
<b>Blood levels of leucine, valine, and isoleucine</b>	As frequently as once a week if you are planning to become pregnant
<b>Blood levels of important nutrients, like vitamin D, vitamin B<sub>12</sub>, folic acid, and essential fatty acids.</b>	These may be checked before your pregnancy, or as soon as your pregnancy is confirmed
<b>Diet Records</b>	As frequently as monthly checks, if you are planning to become pregnant
<b>Measures like your weight and BMI (body mass index)</b>	With each clinic visit

Source: Genetic Metabolic Dietitians International MSUD Guidelines, 2013



# During Your Pregnancy

	<b>When and how often is this checked?</b>
<b>Blood levels of leucine, valine, and isoleucine</b>	Once or twice a week
<b>Levels of all the amino acids in your blood</b>	With each clinic visit
<b>Prealbumin and albumin to check overall protein status</b>	With each clinic visit
<b>Your iron status</b>	With each clinic visit
<b>Urine ketones</b>	These may be checked only if you aren't feeling well or as often as every day!
<b>Diet Records</b>	Once during each trimester, or as often as monthly checks
<b>Measures like your weight and your baby's growth</b>	With each clinic visit
<b>Ultrasound</b>	Once during the first trimester and at 18 to 20 weeks, then once every 4 weeks until you deliver your baby

Source: Genetic Metabolic Dietitians International MSUD Guidelines, 2013





# After Your Pregnancy

	<b>When and how often is this checked?</b>
<b>Blood levels of leucine, valine, and isoleucine</b>	As frequently as once a week for the first 6 weeks after delivery, then once a month
<b>Urine ketones</b>	These may be checked if you aren't feeling well.
<b>Blood levels of important nutrients, like vitamin D, vitamin B<sub>12</sub>, folic acid, essential fatty acids and iron</b>	These levels may be measured again after you have your baby
<b>Diet Records</b>	Once a week for about 6 weeks after you have your baby, then once every 6 months
<b>Measures like your weight and your baby's growth</b>	With each clinic visit

Source: Genetic Metabolic Dietitians International MSUD Guidelines, 2013

# How much weight should I gain during pregnancy?



**Weight gain recommendations differ from woman to woman. Your clinic may have their own guidelines.**

One example of recommendations for weight gain is from the Institute of Medicine. Their recommendations are based on a woman's pre-pregnancy BMI, or body mass index. BMI calculations are based on both your height and weight. Ask your clinic if you are unsure what your pre-pregnancy BMI is.

<b>Pre-pregnancy BMI</b>	<b>Weight Gain during Pregnancy</b>
Less than 18.5	28 to 40 pounds <u>OR</u> 12.5 to 18 kilograms
18.5 to 24.9	25 to 35 pounds <u>OR</u> 11.5 to 16 kilograms
25 to 29.9	15 to 25 pounds <u>OR</u> 7 to 11.5 kilograms
30 or Greater	11 to 20 pounds <u>OR</u> 5 to 9 kilograms

Source: Institute of Medicine, 2009

# Ideas for “Boosting” Your Protein and Energy Intake



**Below are some ideas to increase your calorie intake and how much natural protein (or leucine) you eat.**

These ideas can be helpful in your 2<sup>nd</sup> and 3<sup>rd</sup> trimester of pregnancy when your metabolic team recommends an increase in natural protein and calories.

**If you are interested in trying any of these ideas, speak with your dietitian first.**

**Your dietitian may have additional ideas to help you safely increase your protein intake.**



If your dietitian does recommend adding high protein foods such as regular cheese or beans, she will tell you exactly how much is OK to eat.

Remember it is important to carefully weigh or measure these foods so that you do not eat too much protein!

## For a protein boost:



Mix dry milk powder into beverages like smoothies and coffee, or foods like soups, sauces, and puddings.



Add an egg into sandwiches, wraps, and salads.



Add regular cheese on top of pasta, cooked vegetables, salads and sandwiches.



Add nuts or seeds to yogurt, cereals, and salads. Or, enjoy them as part of a snack.



Add beans or lentils to chili, soups or salads.



Use nut butters as a dip for fruit, like apples, or as a spread on toast and pancakes.

## For a calorie boost:



Add fats, like butter, margarine or oil, to cooked vegetables, creamy soups, and breads.



Add sliced avocado or guacamole to sandwiches, wraps, and salads.



Add vegan cheese on top of pasta, cooked vegetables, salads, and sandwiches.



Add dried fruits to hot or cold cereals, low-protein yogurt, and salads.



Add honey and jams to bread, muffins, or crackers.



Drizzle extra syrup over pancakes, waffles, and desserts.

## Formula Ideas

During the 2<sup>nd</sup> and 3<sup>rd</sup> trimester of pregnancy, you may need to increase how much formula you drink. It may be more than what you are used to, making it harder to meet your goals.



**If your formula can be mixed into foods and beverages, below are some ideas to “switch up” how you take your formula.**



If you mix your formula with water, add sweetened drink crystals. Flavors may differ from brand to brand, but some common ones include lemon, orange, strawberry, and cherry. Or add syrups like chocolate or strawberry.



Blend your formula with fruit and/or veggies to make a refreshing smoothie.



Add some flavoring and partially freeze your formula to make a “slushie.”



Mix your formula into foods like cooked cereals, mashed potatoes or pudding.

**Check with your dietitian to be sure that your formula can be mixed with foods.**

# Recipe Ideas



The next several pages include low protein recipes from resources such as **CookForLove.org** and **Cambrooke Foods**.

- Each recipe provides nutrition information for calorie, protein, and leucine content.
- Each recipe also includes “helpful tips” to increase the recipe’s calorie and/or protein content.

**Before you add a high protein food to any recipe, speak with your dietitian first. Your dietitian may also have additional ideas to help you safely increase your protein intake.**

**If you are unsure of the nutrition information for other recipes you would like to try, let your team know. Your dietitian can help you find this information!**



# Autumn Roasted Vegetable Salad

**Prep Time:** 30 minutes

**Number of Servings:** 11

**Cook Time:** 1 hour

**Serving Size:** ½ cup

**Ready in:** 1 hour and 30 minutes

## Nutrition Information per Serving

<b>Calories: 109</b>	<b>Protein: 1.3 g</b>	<b>Leucine: 75 mg</b>
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## Ingredients

- 2 Tbsp canola oil
- 6 cloves garlic, chopped
- 1 cup onion, cut into ½-inch dice
- 3 ½ carrots, peeled, ½-inch dice
- 1 ⅔ cup potatoes, peeled and cut into ½-inch dice
- 2 cups butternut squash, peeled and cut into ½-inch dice
- 1 ½ cup celery
- ⅙ tsp salt
- ½ tsp black pepper, ground
- 2 Tbsp olive oil
- 1 Tbsp vinegar
- 1 tsp dried sage
- 2 tsp fresh thyme

## Directions

1. Preheat oven to 425 degrees F. In a large bowl, combine the canola oil, garlic, onion, carrots, potatoes, butternut squash, celery root, and salt and pepper to taste. Toss to coat the vegetables well.
2. Spread the vegetables on a rimmed baking sheet in one layer.
3. Roast, stirring once midway, for 25 to 30 minutes or until the vegetables are tender and starting to brown. Transfer the roasted vegetables to the original large bowl.
4. Whisk the olive oil and vinegar together in a small bowl. Add the herbs and vinegar-oil dressing to the roasted vegetables and toss to coat.
5. Serve warm on a bed of greens if desired.

## Helpful Tip

- For more protein, add your choice of nuts, seeds, or cooked quinoa. Check with your dietitian about adding specific amounts.

**Adapted from original recipe on CookForLove.org, created by Virginia Schuett.**

**Gram weights of ingredients in the recipe are available online.**

# Taboule Salad

Number of Servings: 5

Serving Size: 1 cup

## Nutrition Information per Serving

<b>Calories: 350</b>	<b>Protein: 1.2 g</b>	<b>Leucine: 70 mg</b>
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## Ingredients

### For the Taboule:

- 1 cup of your favorite low protein pasta, prepared according to package instructions
- 6 green onions, chopped
- 2 medium tomatoes, seeded and diced
- 1 small cucumber, diced
- 1 cup fresh parsley or cilantro, chopped fine

### For the Dressing:

- ½ cup olive oil
- ¼ cup fresh lemon juice
- 2 cloves garlic, chopped fine
- 1 tsp Dijon mustard
- ½ tsp salt
- Freshly ground pepper, to taste

## Directions

1. **To prepare the Taboule:** In a bowl, mix all of the ingredients for the Taboule together. Set aside as you prepare the dressing.
2. **To prepare the dressing:** In a bowl, combine and whisk all of the ingredients for the dressing.
3. Pour the dressing over the Taboule salad and toss.

## Helpful Tip

- For more protein, replace the low protein pasta with regular pasta, or mix in black beans. You can also try topping the salad with regular cheese, like Feta cheese. Check with your dietitian about adding specific amounts.

Adapted from original recipe on Cambrooke Foods Recipe Page (<https://www.cambrooke.com/recipes/low-protein>).

Gram weights of ingredients in the recipe are available online.

# Vegetarian Chili

**Prep Time:** 20 minutes

**Cook time:** 1 hour and 10 minutes

**Ready in:** 1 hour and 30 minutes

**Number of Servings:** 7

**Serving Size:** 1 cup

## Nutrition Information per Serving

<b>Calories: 153</b>	<b>Protein: 3.4 g</b>	<b>Leucine: 150 mg</b>
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## Ingredients

- 4 ¾ cups eggplant (1 medium), raw, cubed
- 1 Tbsp salt
- 2 ¼ cups zucchini (1 medium) or butternut squash, cut into ½-inch cubes
- ¼ cup olive oil
- 2 cups onion (2 medium), cut into ¼-inch dice
- 4 cloves of garlic, fresh, chopped
- 1 ½ cups bell pepper (1 red or 1 green), cut into ¼-inch dice
- 1-28 oz can of whole tomatoes, diced
- 1 ½ Tbsp chili powder
- 1 ½ tsp cumin, ground
- 1 ½ tsp oregano, ground
- 3 tsp basil, ground
- 2 tsp black pepper, ground
- 1 tsp salt

## Directions

1. Place eggplant in colander, sprinkle with salt, and let stand for at least 1 hour or up to 3 hours. Rinse the eggplant well under running water to remove the salt. Spread the eggplant in an even layer on a triple thickness of paper towels. Press firmly on the eggplant with your hands until the eggplant is dry and feels firm and compressed.
2. Heat oven to 500 degrees Fahrenheit. Toss the eggplant, squash, and two tablespoons of olive oil together in a large bowl. Spread on a baking sheet in a single layer to help them roast evenly. Sprinkle with salt to taste.
3. Roast, stirring every 10 minutes, until well-browned and tender, or about 30 to 40 minutes. Set the eggplant and zucchini aside.
4. Meanwhile, heat the remaining 2 tablespoons of olive oil in a large pot over medium heat. Add the onion and cook until soft and translucent, about 10 minutes.
5. Add the garlic and bell peppers. Sauté for 5 minutes.

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6. Add the tomatoes and the spices and cook for 10 minutes. Add the roasted eggplant and zucchini. Simmer, uncovered, on low heat for 30 minutes.

### **Helpful Tips**

- For more protein, add canned beans of your choice, like kidney beans or black beans along with the roasted eggplant and zucchini. Or, try topping your chili with regular cheese. Check with your dietitian about adding specific amounts.
- For more calories, try topping your chili with low protein cheese or sliced avocado.

**Adapted from original recipe on [CookForLove.org](https://www.cookforlove.org), created by Brenda Winiarski.  
Gram weights of ingredients in the recipe are available online.**

# Veggie Noodle Soup

Prep Time: 15 minutes

Cook time: 35 minutes

Ready in: 50 minutes

Number of Servings: 8

Serving Size: 1 cup

## Nutrition Information per Serving

<b>Calories: 88</b>	<b>Protein: 1.4 g</b>	<b>Leucine: 74 mg</b>
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## Ingredients

### For the Vegetables:

- 2 Tbsp butter
- 1 ¼ cup onion, small dice
- 2 ½ carrots, peeled, diced small
- 1 ¼ cup potato, peeled, diced small
- 2 stalks celery, diced small
- 7 cloves garlic, minced

### For the Broth and Noodles:

- 4 cups clear vegetable broth, ready-to-serve
- 2 Tbsp bay leaves
- 1 ¼ tsp salt
- ½ tsp black pepper, ground
- 1 tsp fresh rosemary
- 1 tsp fresh thyme, minced
- 1 tsp fresh sage, minced
- 2 Tbsp fresh parsley, minced
- ½ roll low protein noodles, Aprotein tagliatelle (~30 g or 1 oz dry)

## Directions

1. Melt butter in medium- to large-sized pot over medium heat. Add onions, carrots, celery, and potatoes and cook for 5 to 8 minutes.
2. Stir in minced garlic, and cook until fragrant, about 1 minute.
3. Add vegetable broth, bay leaves, salt, and pepper to the pot. Increase heat to medium high until boiling. Reduce heat to simmer and cook until vegetables are tender, about 20 to 25 minutes. Remove bay leaves. Add fresh herbs and simmer for another 5 minutes.
4. Meanwhile, in a small- to medium-sized pot, bring water to a rapid boil. Add 1 teaspoon of salt and low protein noodles. Cook for about 5 minutes. Drain, but do not rinse. Add noodles back to the pot.

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5. Portion the soup and vegetables to the pot with the noodles. Simmer for an additional 5 minutes.

### **Helpful Tip**

- For more protein, add canned white cannellini beans or replace the low protein noodles with regular pasta noodles. Check with your dietitian about adding specific amounts.

**Adapted from original recipe on [CookForLove.org](https://www.cookforlove.org), created by Brenda Winiarski.  
Gram weights of ingredients in the recipe are available online.**

# Sloppy Janes

Prep Time: 20 minutes

Cook time: 30 minutes

Ready in: 50 minutes

Number of Servings: 8

Serving Size: 1 sandwich (~80 g)

## Nutrition Information per Serving

<b>Calories: 121</b>	<b>Protein: 2.1 g</b>	<b>Leucine: 86 mg</b>
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## Ingredients

- 2 Tbsp olive oil
- 3 ½ cup portobello or cremini mushrooms, finally diced
  - **Note:** about 3 portobello mushrooms or 15 cremini mushrooms
- 1 ¾ cup eggplant, peeled and finely diced
- 1 cup onion, finely diced
- ½ tsp chili powder
- 2 Tbsp brown sugar
- 1 cup canned tomato sauce, not marinara sauce
- ½ cup ketchup
- 2 Tbsp water
- 2 tsp classic yellow mustard
- 2 ½ tsp Worcestershire sauce
- ½ tsp salt
- 2 Tbsp butter, cold and cut into 8 pieces
- ¼ tsp Tabasco sauce, to taste
- 8 low protein burger buns

## Directions

1. In a large skillet, heat one tablespoon of olive oil over medium high heat. Add the mushrooms, and cook until lightly browned, about 5 to 6 minutes.
2. Add remaining oil and eggplant and onion. Cook an additional 5 minutes, stirring occasionally.
3. Add the garlic and chili powder, and cook for 1 minute.
4. Stir in the brown sugar, tomato sauce, ketchup, water, salt, mustard, and Worcestershire sauce. Simmer for 20 minutes.
5. Season with Tabasco sauce and additional salt and pepper to taste.
6. Add the butter and allow it to melt into the sauce. Add a little extra water if the sauce gets too thick.
7. Spoon ½ cup (~90 grams) of the vegetable mixture onto each low protein burger bun. Top with pickles and bun.



## **Helpful Tips**

- For more protein, replace low protein burger bun with a regular burger bun, or sprinkle regular cheese over vegetable mixture before topping with bun. Check with your dietitian about adding specific amounts.
- If you like regular eggs, add a fried egg as a topping for more protein!
- For more calories, try sliced avocados or guacamole as a topping.

**Adapted from original recipe on [CookForLove.org](https://www.cookforlove.org), created by Brenda Winiarski.  
Gram weights of ingredients in the recipe are available online.**

# Rice Pilaf with Sautéed Vegetables

Number of Servings: 2

Serving Size: 116 g or about ¾ cup

## Nutrition Information per Serving

<b>Calories: 280</b>	<b>Protein: 1 g</b>	<b>Leucine: 45 mg</b>
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## Ingredients

- ½ cup low protein rice, dry
- ¼ tsp vegetable bouillon, or low protein chicken consommé (such as Cambrooke Chicken Consommé)
- 2 Tbsp olive oil
- ¼ tsp turmeric
- ¼ medium onion, sliced
- ¼ medium sweet red pepper, sliced
- ¼ medium sweet yellow pepper, sliced
- 1 small garlic clove, minced

## Directions

1. Cook low protein rice according to package instructions. Rinse and drain thoroughly.
2. Add 1 tablespoon of olive oil, bouillon or consommé, and turmeric to the rice. Mix together and set aside.
3. Heat 1 tablespoon olive oil in a medium skillet over medium heat. Sauté onions, peppers, and garlic until tender, but not wilted.
4. Mix half of the vegetables and rice together, and top with remaining vegetables and serve.

## Helpful Tips

- For more protein, replace the low protein rice with regular rice.
- Another idea is to add canned black beans. Add the beans halfway through sautéing the vegetables, just to heat through. Check with your dietitian about adding specific amounts.

Adapted from original recipe on Cambrooke Foods Recipe Page (<https://www.cambrooke.com/recipes/low-protein/#.XxaM9p5KiUk>).

Gram weights of ingredients in the recipe are available online.

# Onion, Pepper, and Mushroom Quesadillas

**Number of Servings:** 2

**Serving Size:** 1 half of a quesadilla (106 g)

## Nutrition Information per Serving

<b>Calories: 230</b>	<b>Protein: 1.2 g</b>	<b>Leucine: 61 mg</b>
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## Ingredients

- 1 Tablespoon vegetable oil
- ¼ cup onion strips
- ¼ cup bell peppers (any colors), julienne cut
- 2 Tbsp sliced mushrooms
- 1 small clove garlic, chopped
- ¼ tsp chili powder
- ¼ tsp cumin
- ½ tsp salt
- ½ Tbsp fresh cilantro, chopped
- 2 low protein tortilla wraps (such as Cambrooke Tortilla Wraps)
- 2 Tbsp shredded regular cheddar cheese
- Oil for cooking the quesadillas

## Directions

1. Heat oil in a large sauté pan. Add strips of onion and cook for 3 to 5 minutes or until softened.
2. Add mushrooms and garlic and sauté on medium high heat for another 3 to 5 minutes, or until the mushrooms have softened.
3. Sprinkle mixture with chili powder, cumin, salt, and cilantro and mix well. Remove from heat.
4. Lay out 1 tortilla and evenly spread cooked mixture on to tortilla.
5. Sprinkle cheese on top. Cover with the second tortilla wrap. Brush the top lightly with vegetable oil.
6. Heat a clean, nonstick sauté pan and place the quesadilla, oiled side down, into the heated pan. Brush oil on the dry side of the quesadilla.
7. Cook for 3 minutes, or until browned. Flip and cook the other side.
8. Cut quesadilla into 4 pieces and serve.



## Helpful Tips

- For more protein, replace the low protein tortilla wraps with a regular tortilla. You can also add more cheddar cheese. Check with your dietitian about adding specific amounts.
- For more calories, serve with guacamole!

**Adapted from original recipe on Cambrooke Foods Recipe Page (<https://www.cambrooke.com/recipes/low-protein/#.XxaM9p5KiUk>).**

# Protein and Leucine Content in Foods



The lists below include the estimated calories, protein and leucine in a serving of a variety of foods.

- Different brands of foods and beverages, like yogurt or bread, may have different calorie and natural protein content.
- If a food or beverage has a nutrition label, use the information on the label to track your calories and natural protein intake.
- Foods that have an asterisk (\*) next to the leucine content means it was estimated using the Leucine Exchange System. To review the exchange system, see page 14.

Lists of foods that are high in protein, like regular dairy products, beans, nuts and meat, are also included in this section. If you are interested in trying any of these high protein foods, **Speak with your dietitian first.**



# Low and Moderate Protein Foods

## Vegetables

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Asparagus	½ cup	67	13	1.5	86
Broccoli	½ cup	46	16	1	59
Brussels Sprouts, cooked	½ cup	78	30	2	89
Butternut Squash	½ cup	70	32	1	40
Cabbage	½ cup	45	11	1	18
Carrots	½ cup	64	26	1	65
Cauliflower	½ cup	54	13	1	57
Celery	½ cup	51	8	Less than 1	16
Collard Greens, cooked	½ cup	95	31	3	124
Corn	½ cup	75	72	3	267
Cucumber, with peel	½ cup	52	8	Less than 1	15
Eggplant	½ cup	41	10	Less than 1	26
Garlic, raw	1 tsp	3	4	Less than 1	9

Green Beans	½ cup	50	16	1	56
Kale, cooked	½ cup	65	20	2	129
Lettuce (Iceberg)	½ cup	36	5	Less than 1	9
Lettuce (Romaine)	½ cup	24	4	Less than 1	18
Mushrooms	½ cup	35	8	1	42
Onion	½ cup	80	32	1	20
Peas	½ cup	80	62	4	246
Potato, with skin	½ cup	75	58	2	74
Spinach, cooked	½ cup	90	21	3	208
Spaghetti Squash	½ cup	78	21	1	26
Sweet Pepper (Red)	½ cup	75	23	1	27
Sweet Pepper (Green)	½ cup	75	15	1	27
Sweet Potato, with skin	½ cup	67	57	1	61
Tomatoes	½ cup	75	13	1	19
Turnips	½ cup	78	17	1	20
Zucchini	½ cup	62	11	1	44

## Fruits and Dried Fruit

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Apple	1 fruit	182	95	1	24
Apricot	1 fruit	35	17	1	27
Asian Pear	1 fruit	122	51	1	31
Avocado	½ fruit	68	114	1	96
Banana	1 fruit	118	105	1	80
Blueberries	½ cup	74	42	1	33
Cherries	½ cup	69	44	1	21
Cantaloupe	½ cup	80	27	1	23
Dried Fruit (raisins)	¼ cup	41	123	1	40
Dried Fruit (dates)	1 date	24	67	Less than 1	20
Grapefruit	½ cup	115	48	1	17
Grapes	½ cup	76	52	1	17
Honeydew Melon	½ cup	89	32	1	14
Jackfruit	½ cup	83	78	1	85
Mango	½ cup	83	54	Less than 1	26
Nectarines	½ cup	72	32	1	10

Oranges	1 fruit	131	62	1	30
Peach	½ cup	77	30	1	21
Pear	½ cup	70	40	Less than 1	13
Pineapple	½ cup	83	41	1	20
Plum	1 fruit	66	30	1	10
Raspberries	½ cup	62	30	1	31
Strawberries	½ cup	83	27	1	28
Watermelon	½ cup	77	23	1	14

## Grains and Grain Products

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Bread (white)	1 slice	27	78	2	172
Bread (wheat)	1 slice	25	77	4	111
Bread (gluten-free)	1 slice	37	100	1	*70
Breakfast Cereal (Honey Nut Cheerios)	¾ cup	28	107	3	361
Breakfast Cereal (Special K)	¾ cup	23	86	5	358
Breakfast Cereal (Rice Krispies)	¾ cup	21	80	1	113

Breakfast Cereal (Rice Chex)	¾ cup	20	77	1	89
Cream of Rice (Rice Porridge), cooked with water	½ cup	183	95	2	134
Cream of Wheat, cooked with water	½ cup	181	112	3	252
Dinner Roll	1 roll	25	78	3	182
English Muffin (white)	1 muffin	57	134	4	315
Hamburger Bun (white)	1 bun	43	110	4	282
Instant Oats, cooked	½ cup	117	80	3	234
Pasta (regular), dry	½ cup	56	200	7	*490
Pasta (gluten-free), dry	½ cup	56	190	4	*280
Quinoa, cooked	¼ cup	46	56	2	121
Rice (white), cooked	½ cup	79	103	2	175
Rice (brown), cooked	½ cup	98	109	2	186

Tortilla (flour), 6-inch	1 tortilla	30	92	3	109
Tortilla (gluten-free), 6-inch	1 tortilla	49	140	3	*210
Tortilla (corn), 6-inch	1 tortilla	24	52	1	171

## Non-Dairy Products

	Serving Size	Weight (g)	Calories	Protein (g)	Leucine (mg)
Almond Milk, unsweetened	1 cup	240	38	1	89
Coconut Milk (Native Forest brand)	½ cup	121	212	Less than 1	*0
Rice Milk	1 cup	240	50	Less than 1	19
Vegan Cheese (Daiya brand), shredded	¼ cup	28	90	1	*60
Vegan Cheese (Daiya brand), slices	1 slice	22	60	1	*60
Yogurt, non-dairy, made with coconut milk	½ cup	113	53	Less than 1	*0

## Snacks

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Animal Crackers	10 crackers	250	112	2	118
Chocolate Chip Cookies	1 cookie	10	48	1	40
Graham Crackers	2 crackers, square pieces	14	59	1	67
Granola Bar (Nature Valley Brand, Oats 'N Honey)	2 bars	42	190	3	*210
Granola Bar (Kind Bar Brand, Whole Fruit)	1 bar	35	100	1	*70
Popcorn	½ cup	4	21	Less than 1	42
Gluten-free Pretzels (Glutino Brand)	33 pretzels	30	120	Less than 1	*0
Saltine Crackers	4 crackers	12	50	1	78
Sugar Cookies	1 cookie	23	113	1	78
Tortilla Chips	10 chips	28	132	2	352

# High Protein Foods

## Regular Dairy Products

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Cheddar Cheese, shredded	2 Tbsp	14	57	3	274
Cheddar Cheese, slices	1 slice	20	115	7	550
Dry Milk Powder, fat free	1 Tbsp	8	27	3	266
Dry Milk Powder, whole	1 Tbsp	8	40	2	206
Evaporated Milk, fat free	¼ cup	64	50	5	474
Evaporated Milk, whole	¼ cup	63	85	4	420
Milk, skim	1 cup	245	83	8	782
Milk, 2%	1 cup	245	122	8	764
Milk, whole	1 cup	244	149	8	730
Mozzarella Cheese, shredded	2 Tbsp	14	42	3	276
Parmesan Cheese, shredded	2 Tbsp	10	42	4	401

Yogurt, plain, fat-free	½ cup	123	67	7	707
Yogurt, plain, low fat	½ cup	123	77	6	648
Yogurt, plain, full fat	½ cup	123	75	4	429

## Beans and Lentils

	Serving Size	Weight (g)	Calories	Protein (g)	Leucine (mg)
Black Beans, cooked	¼ cup	43	57	4	304
Black-eyed Peas (Cowpeas), cooked	¼ cup	41	40	1	93
Broad or Fava Beans, cooked	¼ cup	43	47	3	243
Chickpeas, cooked	¼ cup	41	67	4	259
Edamame, cooked	¼ cup	39	47	5	289
Hummus	¼ cup	62	109	3	213
Kidney Beans, cooked	¼ cup	44	56	4	307

Lentils (red, green, brown), cooked	¼ cup	50	56	5	324
Navy Beans, cooked	¼ cup	46	64	4	319
Pinto Beans, cooked	¼ cup	43	61	4	284

## Nuts, Nut Butters, and Seeds

	Serving Size	Weight (g)	Calories	Protein (g)	Leucine (mg)
Almonds	2 Tbsp	18	104	4	263
Almond Butter	1 Tbsp	16	98	3	237
Hazelnuts (Filberts)	2 Tbsp	17	106	3	179
Peanuts	2 Tbsp	18	104	5	305
Peanut Butter	1 Tbsp	16	96	4	247
Pepitas (pumpkin seeds)	2 Tbsp	15	85	4	352
Pistachios	2 Tbsp	15	86	3	247
Sunflower Seeds	2 Tbsp	17	104	3	210
Sesame Seeds	2 Tbsp	18	103	3	244
Tahini (Sesame Butter)	1 Tbsp	15	86	3	205
Walnuts	2 Tbsp	15	96	2	171

## Meats and Eggs

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Beef, 75% lean, ground, cooked	1 oz	28	72	7	543
Beef, flank or steak, cooked	1 oz	28	51	8	630
Chicken, breast	1 oz	28	83	5	303
Chicken, thigh	1 oz	28	56	7	557
Egg	1 egg	33	54	4	335
Pork, 84% lean, ground, cooked	1 oz	28	85	8	614
Pork, tenderloin, cooked	1 oz	28	42	7	629
Sausage (pork)	1 oz	28	92	5	386
Sausage (turkey)	1 oz	28	56	7	475
Turkey, breast	1 oz	28	30	5	386
Turkey, thigh	1 oz	28	45	5	417

## Seafood

	<b>Serving Size</b>	<b>Weight (g)</b>	<b>Calories</b>	<b>Protein (g)</b>	<b>Leucine (mg)</b>
Tuna, canned, drained	1 oz	28	36	7	544
Salmon, cooked	1 oz	28	58	6	509
Shrimp, cooked	1 oz	28	34	7	553
White Fish (cod, haddock, pollock), cooked	1 oz	28	49	7	564

# Online and Print Resources

## Online Resources

### Information and Support



- **The MSUD Family Support Group Website**
  - Link: <https://www.msud-support.org/>
- **The MSUD Family Support Group Facebook Page**
  - Link: <https://www.facebook.com/msudfamilysupportgroup/>

### Low Protein Recipes

- **Cook for Love**
  - Link: <https://cookforlove.org/>
- **MSUD Family Support Group Recipes Page**
  - Link: <https://www.msud-support.org/diet-wise>
- **Cambrooke Foods**
  - Link: <https://www.cambrooke.com/recipes/low-protein/>
- **Nutricia Metabolics**
  - Link: <http://www.medicalfood.com/recipes/>

**Note: all of the recipes from these websites include nutrition information, such as calorie, protein, and/or leucine content.**



## Food Lists

- **Leucine and Protein Content of Foods**
  - Developed for the MSUD Family Support Group
  - Link: <https://gmdi.org/Resources/Leucine-and-Protein-Content-of-Foods>

## Tools for Counting Protein/Leucine

- **Metabolic Diet App (FREE)**
  - A free, web-based metabolic diet tracking tool accessible by mobile devices and desktop computers
  - Includes information such as calories, protein, and leucine content for foods and beverages
  - Link: <http://metabolicdietapp.org/>
- **MyFitnessPal (FREE)**
  - A free, web-based diet tracking tool accessible by mobile devices and desktop computers
  - Includes information such as calories and protein content for foods and beverages
  - MyFitness Pal does not include leucine content of the foods.
  - Link: <https://www.myfitnesspal.com/>

# Print Resources

## Cookbooks

- **Apples to Zucchini: A Collection of Favorite Low Protein Recipes (2005), by Virginia E. Schuett and Dorothy Corry**
  - Low protein recipes that focus on fruits and vegetables and are intended to be suitable for the whole family.
  - Includes leucine and protein content for each recipe
- **Low Protein Cookery for Phenylketonuria, Third Edition (1997), by Virginia E. Schuett**
  - Low protein recipes that include protein content for each recipe and helpful hints for managing a low protein diet

## Food Lists

- **Emory University MSUD Food List Booklet**
  - A pocket-sized, comprehensive food list that provides information such as serving sizes, calories, protein, leucine content, and leucine exchanges
  - Also includes information about the Leucine Exchange System and pages to record your own food logs and notes
  - Ask your clinic if you have any questions about purchasing this booklet





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