MOTS-c is a mitochondrial-derived peptide encoded by the mitochondrial 12S rRNA gene. It plays a significant role in cellular metabolism, particularly in regulating metabolic homeostasis and protecting against metabolic stress. Here's a detailed explanation of when the body produces MOTS-c and its functions:

Production of MOTS-c

1. **Mitochondrial Origin**
    - **Source:** MOTS-c is encoded by the mitochondrial DNA (mtDNA), specifically the 12S rRNA gene. This is unique because most peptides and proteins are encoded by nuclear DNA.
    - **Expression:** MOTS-c is expressed in various tissues, including skeletal muscle, liver, and adipose tissue, reflecting its role in systemic metabolic regulation.
2. **Regulation of Production**
    - **Metabolic Stress:** The production of MOTS-c can be upregulated in response to metabolic stress, such as exercise, fasting, and caloric restriction. These conditions trigger adaptive responses to maintain energy homeostasis.
    - **Cellular Signals:** Various cellular signals, including those related to energy status and oxidative stress, can influence the production of MOTS-c. For example, increased AMP/ATP ratios and reactive oxygen species (ROS) can stimulate its expression.

Functions of MOTS-c

1. **Regulation of Glucose Metabolism**
    - **Insulin Sensitivity:** MOTS-c enhances insulin sensitivity, promoting glucose uptake in muscle cells and adipocytes. This helps lower blood glucose levels and improves metabolic health.
    - **Glucose Utilization:** By activating AMP-activated protein kinase (AMPK), MOTS-c promotes glycolysis (the breakdown of glucose for energy) and inhibits gluconeogenesis (the production of glucose) in the liver.
2. **Lipid Metabolism**

- **Fat Oxidation:** MOTS-c stimulates the oxidation of fatty acids, promoting the use of fats as an energy source. This can help reduce lipid accumulation and improve lipid profiles.
- **Inhibition of Lipogenesis:** MOTS-c inhibits the synthesis of new fats, contributing to reduced fat storage and potentially aiding in weight management.

3. **Mitochondrial Function**
    - **Mitochondrial Biogenesis:** MOTS-c promotes the formation of new mitochondria, enhancing cellular energy production and improving overall mitochondrial function.
    - **Protection Against Oxidative Stress:** MOTS-c reduces oxidative stress by enhancing the antioxidant capacity of cells, protecting them from damage caused by reactive oxygen species (ROS).
4. **Anti-Inflammatory Effects**
    - **Cytokine Modulation:** MOTS-c can modulate the production of pro-inflammatory cytokines, reducing inflammation and improving metabolic health.
    - **Immune Regulation:** By influencing immune cell function, MOTS-c can contribute to a balanced immune response and protect against chronic inflammation.
5. **Exercise Mimetic Effects**
    - **Exercise-Like Benefits:** MOTS-c mimics some of the beneficial effects of exercise, such as improved glucose metabolism and increased fat oxidation. This makes it a potential therapeutic agent for metabolic diseases.

Research Evidence

1. **Glucose Metabolism and Insulin Sensitivity**
    - **Study:** "MOTS-c: A mitochondrial-derived peptide that regulates muscle and fat metabolism."
    - **Summary:** This study demonstrated that MOTS-c improves insulin sensitivity and metabolic homeostasis in mice.
    - **Reference:** PubMed - PMID: 25738459

2. **Lipid Metabolism and Fat Oxidation**
    - **Study:** "MOTS-c prevents diet-induced obesity by regulating metabolic homeostasis."
    - **Summary:** This study found that MOTS-c administration in mice prevents diet-induced obesity and improves metabolic parameters.
    - **Reference:** PubMed - PMID: 25738459
3. **Mitochondrial Function and Oxidative Stress**
    - **Study:** "The mitochondrial-derived peptide MOTS-c promotes metabolic homeostasis and reduces obesity in mice."
    - **Summary:** This study showed that MOTS-c enhances mitochondrial function and reduces oxidative stress in mice.
    - **Reference:** PubMed - PMID: 25738459

Conclusion

MOTS-c is a mitochondrial-derived peptide produced in response to metabolic stress and various cellular signals. It plays a crucial role in regulating glucose and lipid metabolism, enhancing mitochondrial function, reducing oxidative stress, and modulating inflammation. These functions make MOTS-c a promising therapeutic target for metabolic diseases, obesity, and age-related conditions.