Food Efficiency Calculation Explained

Overview

The `calculateFoodEfficiency` function computes how efficiently your body can utilize the energy from meals based on multiple biological and physiological factors. The efficiency score ranges from 0-100%, representing the percentage of calories that are effectively used by your body.

Core Components

1. Macronutrient Balance Factors

The system analyzes the macronutrient composition of each meal:

- **Protein Factor**: `protein_grams × 0.2`
- **Carbohydrate Factor**: `carb_grams × 0.1`
- **Fat Factor**: `fat_grams × 0.15`

These factors reflect the thermic effect of food (energy cost of digestion) and metabolic benefits of each macronutrient. Protein has the highest factor (0.2) because it requires more energy to process and has better satiety effects.

Base Macro Balance Score: `min(100, (protein_factor + carb_factor + fat_factor) × 10)`

2. Circadian Rhythm (Time-Based) Factors

Your metabolism varies throughout the day based on natural circadian rhythms:

- **Early Morning/Late Night** (before 6 AM or after 8 PM): **0.7x** (70% efficiency)
- **Optimal Morning** (7-10 AM): **1.2x** (120% efficiency - peak metabolism)
- **Evening** (5-7 PM): **0.9x** (90% efficiency - declining metabolism)
- **All Other Times**: **1.0x** (100% baseline efficiency)

3. Meal Type Optimization Factors

Different meal types have different efficiency multipliers based on metabolic expectations:

- **Breakfast**: **1.3x** (130%) - Highest efficiency, breaks overnight fast
- **Morning Snack**: **0.9x** (90%) - Good mid-morning metabolism
- **Lunch**: **1.1x** (110%) - Strong midday metabolism
- **Afternoon Snack**: **0.8x** (80%) - Decent afternoon metabolism

- **Dinner**: **0.9x** (90%) - Reduced evening metabolism
- **Late Night Snack**: **0.6x** (60%) - Lowest efficiency, disrupts circadian rhythm

4. Long COVID Metabolic Adjustments

For users with Long COVID, additional factors are applied:

Metabolic Efficiency Reduction

Based on severity level, metabolic efficiency is reduced:

- **Mild**: 95% efficiency (5% reduction)
- **Moderate**: 85% efficiency (15% reduction)
- **Severe**: 75% efficiency (25% reduction)
- **Very Severe**: 65% efficiency (35% reduction)

Food-Specific Adjustments

- **Beneficial Foods**: +10% efficiency boost
- **Problematic Foods**: -10% efficiency penalty

Final Calculation Formula

```
Base Efficiency = Macro Balance Score × Time Factor × Meal Type Factor

If Long COVID:
    Final Efficiency = Base Efficiency × Severity Factor × Food Benefits/Penalties

Final Score = min(100, max(0, Final Efficiency))
```

Practical Example

Example Meal: Breakfast at 8:00 AM

- Protein: 25g → Factor: 5.0
- Carbs: 40g → Factor: 4.0
- Fat: 15g → Factor: 2.25
- Macro Balance: (5.0 + 4.0 + 2.25) × 10 = 112.5 → capped at 100
- Time Factor: 1.2 (optimal morning time)
- Meal Type Factor: 1.3 (breakfast bonus)

- **Base Efficiency**: 100 × 1.2 × 1.3 = **156** → capped at 100%

With Moderate Long COVID:

- Severity Factor: 0.85 (15% reduction)
- **Final Efficiency**: 100 × 0.85 = **85%**

Key Insights

1. **Breakfast is King**: Highest efficiency due to both circadian rhythm and meal type factors
2. **Timing Matters**: The same meal can have vastly different efficiency scores based on when it's consumed
3. **Long COVID Impact**: Significantly reduces metabolic efficiency, requiring strategic meal planning
4. **Macronutrient Balance**: Higher protein content generally improves efficiency scores
5. **Late Night Penalty**: Late night eating is heavily penalized due to poor metabolic timing

Efficiency Score Interpretation

- **90-100%**: Excellent efficiency - optimal timing and composition
- **80-89%**: Good efficiency - minor optimization opportunities
- **70-79%**: Moderate efficiency - consider timing or composition changes
- **60-69%**: Poor efficiency - significant room for improvement
- **Below 60%**: Very poor efficiency - major meal timing or composition issues

This system helps users understand not just *what* to eat, but *when* and *how* to eat for optimal energy utilization, especially important for those managing Long COVID fatigue.