NATIONAL
ANIMAL
NUTRITION
PROGRAM

Common Units of Measurement and Unit Conversion

The two major systems of measurement used in nutrition are the English and Systems International (SI) units of measurement. The SI system of units (often referred to as the metric system) is the official system for measurements in nearly all countries of the world, except the U.S. As with other fields, nutrition requires a global perspective, so the ability to recognize and convert between English and SI (metric) conventions is a critical skill.

Common Absolute Units of Mass

English System	SI (metric) System
ounce, oz	nanogram, ng
pound, lb	microgram, µg
ton (U.S., short), T	milligram, mg
	gram, g
	kilogram, kg
	tonne (metric), MT

Common Absolute Units of Energy

English System	SI (metric) System
calorie, cal	joule, J
kilocalorie, kcal	kilojoule, kJ
megacalorie, Mcal	megajoule, MJ

Common (Relative) Units of Concentration

percent, %
parts per million, ppm
parts per billion, ppb
grams per ton, g/T

calories per gram, cal/g
kilocalories per pound, kcal/lb
IU per pound, IU/lb
IU per kilogram, IU/kg

milligrams per pound, mg/lb
milligrams per kilogram, mg/kg

Definitions

Calorie:
One calorie (lowercase “c” or cal) is the amount of heat required to raise the temperature of one gram of water by 1°C from 14.5°C to 15.5°C. In human nutrition, 1 Calorie (capital “C” or Cal) equals 1,000 calories or 1 kcal. In animal nutrition, we typically work with kilocalories and megacalories, where 1,000 kcal equals 1 Mcal.

International unit (IU):
A standard unit of potency typically ascribed to nutrients (e.g., vitamins) and non-nutritive feed additives (e.g., hormones, antibiotics, antitoxins, etc.). Also referred to as a United States Pharmacopeia (USP) unit in the U.S., an IU must be defined for each substance in terms of the activity relative to a standard (comparator) quantity or preparation.

Unit Conversion

1.0 lb = 453.6 grams (commonly rounded to 454 g) = 0.4536 kg

1.0 kg = 2.205 lbs

1.0 ton (short) = 2,000 lbs = 907.2 kg

1.0 tonne (MT) = 1,000 kg = 2,205 lbs

1.0 oz = 28.35 g

1.0 g = 1,000 mg = 1,000,000 µg = 1,000,000,000 ng

1.0 kg = 1×10^{3} g = 1×10^{6} mg = 1×10^{9} µg = 1×10^{12} ng

1.0 ppm = 1 mg/kg = 0.0001% (100 ppm = 0.01%)

1.0% = 10,000 ppm

1.0 cal = 4.184 J

1.0 kcal = 4.184 kJ = 1,000 cal = 1 Cal

When converting from one unit of measurement to another, ensure that you cancel out terms to arrive at the correct final units. Because the mathematical operation used in unit conversion is multiplication, simply follow the units in the numerator and denominator. When two terms are multiplied together and have units in opposite locations, they are eliminated from the equation as is the case in the following example calculations:

Eq 1

$$7.5 \text{ lbs of feed} \times \frac{454 \text{ g}}{1 \text{ lb}} = 3{,}405 \text{ g of feed}$$

Eq 2

$$4 \text{ tons of feed} \times \frac{907.2 \text{ kg}}{1 \text{ ton}} = 3{,}628.8 \text{ kg of feed}$$

Eq 3

$$3 \text{ ppm copper} = \frac{3 \text{ mg copper}}{\text{kg of feed}} \times \frac{\text{kg}}{2.205 \text{ lbs}} = \frac{1.36 \text{ mg copper}}{\text{lb of feed}}$$

Eq 4

$$\frac{4{,}400 \text{ IU vitamin A}}{\text{kg of feed}} \times \frac{\text{kg}}{2.205 \text{ lbs}} = \frac{1{,}995.5 \text{ U vitamin A}}{\text{lb of feed}}$$

Eq 5

$$\frac{5{,}844 \text{ kJ}}{\text{lb of feed}} \times \frac{2.2 \text{ lbs}}{\text{kg}} \times \frac{1 \text{ kcal}}{4.184 \text{ kJ}} = \frac{3{,}073 \text{ kcal}}{\text{kg of feed}}$$