C:N Ratios for Organic Materials

Ranked generally from highest N (narrow C:N) to lowest N materials (wide C:N)		
Material	**C:N**	**Comments**
High Nitrogen "Party Food" **C:N 5:1 to 10:1 range**	**Rapid microbial growth expected**	**Many factors influence C and N concentrations in any materials. This column points out the major factors: other factors will need to be added as fine-tuning occurs.**
Meat / Meat broth **Blood Meal** **Fish Hydrolysate**	3 – 10:1	High in amino acids and proteins Be aware that too much of such high N material can cause organisms to grow very rapidly, use up all the oxygen very quickly, and cause the pile to become anaerobic. Organisms are growing very fast, and generating lots of heat, which can cause spontaneous combustion. DON'T OVERFEED!!!!!
Bone Meal	5 – 30:1	Depends on the amount of marrow (high N) left in the bones when the bones are ground up. Again, DO NOT OVER FEED given the consequences of anaerobic conditions developing.
Fish Hydrolysate / Emulsion	Emulsion: 3 - 5:1 Hydrolysate 5 – 10:1	Different fish contain amounts of fats and oils. The higher the fat and oil content, the wider the C:N. The oils are best for growing fungi. Hydrolysate is usually ground up whole fish, except for the fillets while emulsion has had the oils removed, leaving the ground up scales, bones, organ meat, skin, etc.
Chicken Manure Composted Chicken Manure	3 - 10:1 20 – 100:1	If the chickens are fed grains and food wastes including meat, the manure will be very high in N. If the chickens eat mostly insects / grubs with wide C:N, the manure will contain less N. If

Chicken Bedding (manure mixed straw, chips, brown leaves, etc)	Calculate C:N of the mix by estimating how much 10:1 manure and how much 100:1 bedding	the manure remains wet, anaerobic conditions will prevail, and ammonia gas will be released, dropping N to very low levels.
Cow Manure Cow bedding (cow manure mixed with dry, woody materials)	10 - 20:1 Calculate C:N by estimating how much 10:1 manure and how much 100:1 bedding	Depends on how much high N versus high C food the cows are being fed. How long is the manure pile wet, and/or anaerobic, losing ammonia gas?
Pig Manure Pig bedding (pig manure mixed with dry, woody materials)	3 - 20:1 Calculate C:N by estimating how much 10:1 manure and how much 100:1 bedding	Depends on how much high N versus high C food the pigs are being fed. How long is the manure pile wet, and/or anaerobic, losing ammonia gas?
Horse manure Goat, sheep, rabbit manure	10 – 20:1 20:1 – 30:1	Avoid any manure from animals fed de-worming materials. Pay attention to what the horses are eating/being fed. Poor quality pasture means poor quality manure; grain fed animals means high N.
Manure mixed with bedding	10 - 60:1	Bedding absorbs moisture, prevents anaerobic conditions and thus odors, for a limited time. When smells begin to occur, replace the old bedding/ manure mix with new. C:N of bedding needs to be estimated as it is a balance of manure (high N) and bedding (woody; consisting of straw, dry leaves, wood chips, etc.).
Green Legumes (alfalfa, clover, peas, beans, trefoils, etc) - With nodules/red inside - No nodules, or some other color than red inside	10:1 – 30:1 10:1, perhaps even 5:1 30 – 60:1 60:1 or higher	Legumes need nitrogen-fixing bacteria, i.e., Rhizobium to obtain the N they need in most cases (unless inorganic soluble N is added as fertilizer). To be certain N is being fixed, marble size nodules on the root system should be present. Make certain the nodule is pink to red inside, preferably looking like a bright

- Standing dead; dry brown: all nutrients transferred to the roots or seeds		red drop of blood and the legume will be fixing N and reach C:N of 10.
Grains / Seeds Just the germ (seed coat removed) Germ plus Seed Coat Just seed coat (e.g., rice hulls) Hard Shells	 8 - 10:1 25 – 30:1 80 – 150:1 30 – 150:1	The germ, or the viable part of the seed, is high in amino acids and proteins, and that is party food for the microbes. Fermentation of grains often removes the seed coat so the germ becomes much easier to get to. Or, use a grain mill, intended to crack the grains for beer mash, to crack the grain for the use of a High-N source. Otherwise, energy expended to get to the germ may be about equal to the energy gained from decomposing the germ. Nuts, like walnuts, pecans, and peanuts, are protected by very recalcitrant, hard-to-decompose shells whose C:N is often upwards of 150:1. The inner layers of the nut are typically high N, stored on the inside of the shell.
Hair/fur - Cleaning hair or fur may strip natural oils, while hairspray may be very detrimental to microbes that would decompose this material	10 - 30:1 But may be very slow to decompose because the filaments may align, restricting the organisms that can decompose this material	Complex chains of amino acids (one or more will be a disulfide amino acid). The amino acid sequence will align with other keratins to make filaments, making decomposition difficult unless the correct sets of microbes are present. Oils and organic matter mixed in the hair will alter C:N.
Green Plant Materials:	**Food for bacteria; Maintain temperatures**	**Bacterial Foods, relatively simple structures, easy-to-use so bacterial win**
Food scraps: What is the mix of foods?	Any C:N is possible, from 10:1 to 500:1. Normal range of 30:1 Eyeball the mix and give it your best guess.	Food scraps can be a mix of: Meat Green plant materials Woody materials Monitor how fast the pile starts to heat once the pile is mixed and has adequate moisture.

Compost - Incomplete thermal compost	20 – 50:1	Depends on the C:N of input stock materials and the degree of composting already achieved. Not fully composted materials (for example, failed thermal compost) which still retain a measure of nitrogen that will support rapid bacterial growth and, hence, heat production.
Vegetables: Green with sap still inside Green but with no sap inside Standing dead; dry brown, all nutrients transferred into the roots or seeds Roots Seeds	 25 – 30:1 30 -60:1 60 – 200:1 30:1 – 100:1 10:1 – 30:1	The parts eaten by humans / animals are usually 30:1 as the sap or flesh contains amino acids, proteins and sugars The plant will move nutrients from the stalks and leaves in order to contain the nutrient content in the flowers and seeds. Once the crop is harvested, the stalks and leaves will have any remaining nutrients translocated into the roots. Values for annual root systems are usually very wide, while perennial roots can be narrow, but these nutrients are protected by terpenes and noxious flavors.
Green plants including weeds First flush of growth after dormant period (winter, or dry season) Green with sap inside Green but no or little sap Standing dead material (all nutrients pulled back into the crown and roots) Brown leaves, stalks, cobs (all nutrients pulled into the roots)	On average, 30:1 10 - 15:1 25 - 30:1 30 – 60:1 60 – 200:1 60 – 200:1	Plants that humans do not normally grow for food are typically 30:1, except that the nutrients coming from the seed or perennial roots are mobilized all at once, so the first flush of growth is high N, which is rapidly diluted as the plant begins to photosynthesize sugars. Any nutrient deficiency in flowers or seeds will result in the plant taking nutrients away from the stems and leaves to feed the flowers and seeds, causing the green stems and leaves to look more and more yellow. As seeds disperse, the plant takes any remaining nutrients in the aboveground plant material and stores it in the roots.
Seaweed / Kelp	25:1 – 50:1	If cut when rapidly growing, C:N will be narrower (25:1) than when the

		plant is older, or close to death (50:1). In most cases added as bacterial food, slight boost to fungi.
Coffee Grounds Coffee Parchment or Chaff	15 - 45:1 10:1	Oils and other soluble elements are removed during the coffee brewing process. Pre-brewing grounds have a wider C:N (30– 45:1) than used coffee grounds (15 – 30:1).
Humus - **the dark brown color of compost**	30 - 50:1 With the right set of microbes and high disturbance, may decompose rapidly	Humus is made in the O horizon of soil, and is a mix of very complex, highly condensed organic compounds (e.g., humic and fulvic acids), mixed with less decomposed materials as well as fresh, undecomposed organic matter.
Woody / Brown Materials	**Fungal foods!**	Fungal foods, complex, difficult to decompose without the correct enzymes
Humic acids (HA) **Fulvic acids** (FA) - complex, highly condensed, carbon compounds with half lives of 500 years or more if disturbance in minimized - can be destroyed in less than 20 years if soil is over-tilled	250 - 500:1	Most HA/FA are extracted from soft brown coal (Leonardite) and are chemically denatured. Water-extracted HA/FA are not chemically altered and are more likely to grow beneficial fungi, if the correct organisms are present.
Wood Ash - Be careful of additives used to get the wood to burn.	50 – 300:1 Nutrients may be concentrated when the carbon is blown off as CO2	N, P, S and other volatile compounds will be lost when wood is burned. Inorganic forms of K, Na, and Cl can be formed, and reach high concentrations, killing beneficials.

Wood - bark - deciduous wood - conifer / evergreen - Nitrogen-fixing trees - Leaves - Twigs - Trunk	250 – 1000:1 100 – 2000 200 - 600 300 – 1000 10 – 20:1 15 – 30:1 50 – 100:1	Different types of trees make different types and combinations of terpenes and tannins to prevent microbial attack. Terpenes and tannins are structurally very complex and high-in-carbon materials that suppress microbial growth. Nitrogen-fixing trees depend on symbiotic bacteria in their root system, but quite often, these bacteria do not produce nodules. Thus the only way to know if the plant materials are high N is to monitor temperature in the first 24 to 48 hours of the pile.
Peat moss - Pay close attention to the mix of material in the "peat moss"	20 – 150:1	Peat moss varies all over the board, based on what is exactly in the mix. Material with mostly stems of plants that were growing on the moss will have a C:N like plant stalks. Peat moss that is mostly sphagnum will have a narrow C:N if the moss was actually fixing N. So, another situation where testing is required
Brown leaves / needles - Break up mats, get air into all parts of the pile. Chop into smaller sizes. - Addition of fungi able to decompose more difficult materials may be necessary	60 – 300:1	After removal of nutrients into the root system, mostly just carbon is left, which selects for fungi and against bacteria. Aromatic compounds can slow and at times kill beneficial and disease-causing organisms. Turn, fluff, and aerate the pile to speed volatilization.
Paper - e.g., paper plates, toilet paper, paper towels, newspaper - Ink used to print words on paper is soy-based and thus is significantly higher in N. The more ink, the closer to the 70:1 ratio. Lead-based inks are no longer allowed, but several bright colors still are heavy-metal (not lead)	70 - 200:1	Some paper products (e.g., glossy paper) use tackifiers to hold the paper fibers together before being pressed and dried. Some of these tackifiers appear to be quite harmful to some types of beneficial bacteria and fungi.

based. Avoid using paper materials with those colors.		
Cardboard - Inks used on boxes are usually soy-based. Again, bright colors may contain some heavy-metals	300 - 600:1	The glues used to glue the layers of cardboard together are very good fungal foods and will often result in a massive growth of one or two species of fungi.
Wood chips - More surface area once chipped, increases surfaces for the fungi to do their job	150 - 1000:1	Aromatic compounds left in the wood or bark can slow and at times kill beneficial and disease-causing organisms. Turn, fluff, and aerate the pile to speed volatilization.
Biochar	100:1	Adding 10% of Biochar of the total mass of the brown material, **biochar in composting** reduces the peak rate of N_2O emissions by ~60% and increases inorganic N retention in final **biochar-compost** by ~70%. Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5920545/
Sawdust - Can cause difficulties because particle size is too small, resulting in dense piles with no air passageways and the potential for anaerobic conditions.	300 - 700:1	High surface area: If structure is imposed by mixing with char, twigs, green plants material, for example, the wood can decompose rapidly. If airways are not maintained, spontaneous combustion could occur.
Compost - Finished thermal compost - Spent mushroom waste has not been composted and does not contain the soil or compost organisms desired - Worm or vermi-compost - Soil	20 – 50:1 20 -30:1 40 – 100:1 20 – 40:1 15 – 20:1	Depends on the ratio of the three groups of starting materials. The more fungal foods added, the wider C:N; the more high N, the narrower the C:N. “Finished” means the compost has returned to ambient temperature after temperatures were high enough for long enough to deal with diseases, pests, parasites and weed seeds. Spent mushroom waste contains ONE species of fungus. The blocks the

		mushrooms were grown on are far from depleted, and are good food resources for fungi in compost piles. Compost does not contain "party food" even though the C:N is narrow. Thus, C:N is not the end-all and be-all of trying to figure out a recipe. Soil has a C:N of 20:1, but addition of soil to a compost pile does not result in rapid microbial growth. The N has already been used by the microbes and are in stable forms in the compost.

Woody Materials

Woody materials, with their low nitrogen content, or with nitrogen that is bound into macromolecules that are energetically expensive to metabolize, do not contribute significantly to the heat production in the compost pile. They do, however, provide excellent resources for fungal growth. Woody materials have a C:N ratio above 60:1. This category includes all types of chipped wood, dry leaves or needles that have browned on the limb or been shed, brown harvest residues, shredded cardboard, shredded newspaper, pine shavings, animal beddings, etc. (see Table 1). All these materials contribute to the fungal growth in the pile.

A good strategy for introducing more fungi into your compost is to create a wood chip pile, supplemented with fungal foods strewn throughout. If kept moist, a stock of indigenous fungi can be grown on the wood chips. A small amount (at least one bucket, preferably containing visible mycelium) from this fungal pile can then serve as part of the woody component in future compost piles.

Storage of Starting Materials

The Soil Foodweb School does not recommend the addition of materials to a pile gradually over the course of several days or weeks. Instead, the starting materials used to build a BioComplete™ Compost pile should be stockpiled in advance so that a pile can be assembled all at once. This ensures that all materials in the pile are properly