

Protein Supplements and Substitutions

The word-complete-substitute isn't possible because honey bee total nutrition requirements are unknown.

Pollen Preference:

- Fresh pollen
- Frozen pollen
- Dried pollen
- Recipes containing a portion of pollen
- Substitutes will not stimulate colony to rear brood past 2 brood cycles when no pollen is available by any other means.

Note: Gamma irradiated kills American Foulbrood (AFB) spores in pollen. Beekeeper's own pollen could be fed back to colony without radiation. Purchasing pollen could be more feasible than trapping pollen.

Pollen substitutes and dry pollen that is collected in a trap and processed by the beekeeper and then refeed inside the hive - like on the top bars- is *not* processed into bee bread. It is only eaten by adult bees directly. Any long-term interruption of this natural process of pollen collection and the generation of bee bread is therefore more deleterious to the colony's health than the benefits of refeeding pollen later in the season. *Certified Naturally Grown (CNG)*

Pollen Storage:

- Drying quickly reduces pollen nutrients. Pollen moisture content is

10%-20%.

- Twelve months or older pollen limits brood production.
- Dry pollen stored for 2 or more years fails to satisfy nutrient requirements unless irradiated.
- Freeze at -15°C to retain nutrient value; reduced nutrients after 2-3 years stored.
- Vitamins and proteins deteriorate at lower temperatures and fats will oxidize. Minerals and sugars remain relatively stable.

Signs of Adequate Colony Protein:

- Colony is raising drones. Drones require a large amount of protein.
- A frame displaying 60% capped brood vs. open brood - 30% capped brood vs. open brood could mean bee food is not being produced.

Amount of Pollen:

- First 7-10 day adults need large amounts of pollen to develop their hypopharyngeal and mandibular glands.
- Rearing one larva requires 25-37.5mg protein = 125-187.5mg pollen; 2 pollen pellets weigh 7.7-8.6mg; 43.6 pollen pellets or 21.8 pollen forage loads for one larva
- 163mg of honey to rear one egg to pupal stage. 121g of honey (energy stored) to raise 1000 adults from an age mixed brood comb.

Base Recipe:

Pollen	10%-25%
Soy Flour	20%-100%
Yeast	20%-25%
Sugar/honey/water	20%-50%

- Fresh nectar should be available to foraging bees
- or sugar syrup should be provided
- otherwise, pollen supplementary be an expensive method of feeding sugar.

Rule of Thumb: Feed enough supplement so that the colony doesn't run out until your next visit or a natural pollen source pollen source becomes available.

Placement: Supplement should be in close proximity to uncapped larvae brood where the nurse bees have ready access to it.

Pollen Pellets: Pellets should first be dissolved in water (1/3 gallon of water for each pound of pollen pellets) since they don't readily soften in sucrose syrup.

10%-12% pollen improves palatability

25%-30% pollen improves quality and quantity of essential nutrients.

When: If a colony is collecting low quality pollen. Any short term periods (3-6 weeks) when pollen is limited in the field or inclement weather prevents its collection.

Shelf Life: Purchased supplements don't have a shelf life. "Old" supplements fed to colonies either produce:

1. disappointing results
2. have a toxic effect on the colony

3. results are influenced by the race of queen heading colony. Italians will respond more rapidly in food supply than Carniolans.

Bee Bread

Recipe One:

Bee Bread To produce bee bread, fill a container 75-80% of its volume with pollen. The container must be sealable and airtight. To this pollen add a starter culture made from *Lactobacillus xylosus* or Lactobacilli contained in whey. The recipe should be in parts of weight: 10 pollen, 1.5 honey, 2.5 clean water, 0.02 whey or a very small quantity of dried lactic acid bacteria. Leave the container sealed for storage. The process should first take place at temperatures between 28-32°C. After two or three days this temperature should be dropped to 20°C but not below 18°C. After 8-12 days at 20°C the fermentation process should be complete. With the high initial temperatures this will promote the growth of the lactic acid producing bacteria over other yeasts. The desirable bacteria should dominate after two or three days. If done correctly this will preserve its nutrient value and extend its shelf life considerable, said to be almost unlimited. *Fat Bees, Skinny Bees – Manual on Honey Bee Nutrition for Beekeeper*, p. 30

- There are 13 unique Lactobacillus species in the honey stomach of worker bees.
- Bee bread differs in protein concentration and amino acid content from pollens used to create them.

Fermented Pollen Patty

Fermented pollen 1080g pollen

435g syrup (2:1 sugar:water)

60g yogurt

Mix and store the diet(s) in plastic, sealed container placed in an incubator at 30°C for 3 days and then at room temperature (~23°C) for > 2weeks. Patties weighed 250g pressed between two sheets of waxed paper.

We used off-the-shelf “Silk Soy Yogurt” to inoculate soy-based commercially available food supplements to promote the fermentation process. We chose this product because it contained multiple fermentation bacteria: *Lactobacillus bulgaricus*, *L. acidophilus*, *L. casei*, *L. rhamnosus*, *Streptococcus thermophiles* and *Bifidobacterium bifidum* to pre-digest the soy flour and produce a near beebread-like fermented food. Amanda M. Ellis and G. W. Hayes, Jr, “An evaluation of fresh versus fermented diets for honey bees (*Apis mellifera*)”, 25 March 2009

Commercial Protein Feed

2006 (Gregory) Longevity ranked fresh pollen> Feed Bee> Bee-Pro> old pollen

2008 (Degrandi-Hoffman et al.) – Bee-Pro® and MegaBee® patties were consumed at rates similar to pollen cake, but Feed-Bee® was consumed significantly less. MegaBee® appeared to be superior to both Bee-Pro® and Feed-Bee® in terms of brood production or adult population.

2010 Brood Builder® and Bee-Pro® are soy-based
Feed-Bee® and MegaBee® are non-soy-based
Insufficient information for Bee-Pol

Ingredients Found in Commercial Patties

- Vitamin, mineral & amino acid additives for livestock have not been formulated for insects. Sheep and cattle mineral supplements are shown unsatisfactory for adult bees; lacking potassium & contain excessive calcium and sodium.
- Use oil with caution, certain fatty acids is toxic to honey bees.
- Soy flour is low in vitamin B complex.
- Solvent extracted soy has a high risk of residues of Hexane which is toxic to honey bees; chemicals interfere with the digestion of proteins. 50% protein. (Soy protein isolate leaves residues of aluminum and Hexane.)
- Expeller processed soy – depending on the amount of processing heat, the protein can be denatured and made unavailable. 50% protein, oil 6%.
- Full fat soy – has high anti-nutritional factors.
- Baker's soy flour – highest levels of anti-nutritional factors. 38% protein, oil 18%.
- Expander full fat soy has reduced levels of anti-nutritional factors. 34% protein, oil 14%
- Brewers Yeast can contain up to 12% sodium and varying ash content.
- 40% soy sugars are toxic to bees.
- Egg is difficult for bees to digest because of the high lipid content & high fat levels; deteriorate and oxidizes over time with loss in nutritive value.
- Canola flour is lower in protein than soy flour and not attractive to bees.

- Sunflower flour lower in protein than soy flour and has a repellent property bees avoid consuming.
- Sorghum flour and triticale flour low in crude protein but attractive to bees.
- Amino-B Booster™, Honey-B-Healthy & 1:1 sucrose syrup are synergistic.

Minerals:

- 0.5% - 1% ash level reared greatest brood.
- 2% ash demonstrated a decline in brood.
- 8% ash almost ceased brood rearing.
- Sodium above .125% reduces longevity.

Vitamins:

- B complex vitamins have been demonstrated to be essential to most insects.
Assumption is that honey bees follow the same pattern.
- 20% yeast is added to mixture to satisfy B complex missing in soy flour.

Lipids:

- 0.01% cholesterol or 24-methylenecholesterol satisfied by pollen.

- Total lipid concentration within a pollen supplement should probably be between 5%-8%.

Crude Protein (CP)

- CP is a measure of its nitrogen content multiplied by a factor of 6.25.
- Pollens with a low CP% and limiting in one or more amino acids is a much greater concern than pollens with a high CP% limited in one or more amino acids.
- CP is expressed as a % of the dry matter of the pollen pellet.

Increase Pollen Foraging:

- Internal syrup feeders have shown to increase the number of field bees collecting pollen. Stop syrup and the number of pollen gathers declines even with large brood areas.
- Fresh syrup stimulates rood rearing.
- Morning feeding recruits more pollen foragers.

- Feeding 1 litre every day is more effective in pollen recruitment than feeding 3 litres every three days.

Please consider reading the COBKA Bee School 2013 nutrition session - *Apis mellifera* Nutrition - it is writing based on published research. Protein Supplements and Substitutions is a continuation in the understanding of *Apis mellifera* Nutrition and again based on published research.

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