EXTERNAL SCIENTIFIC REPORT

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Pollen supplements and substitutes in the EU feed market: a product/market survey for bees and other animal species

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Abstract

A survey to overview the presence of pollen supplements and substitutes for bees and other animal species in the EU was conducted to serve as input for the regulatory risk assessment of genetically modified feed by the EFSA GMO Panel. A comprehensive mapping of the possible presence of pollen collected by honey bees in the feed supply chain requires an understanding of the production in the EU as well as the flow of imports from non-EU to EU countries. The different uses of pollen as feed supplement were compiled by both identifying products being offered as well as the scientific and grey literature describing the applicability of pollen as feed for invertebrates such as honey bees and bumble bees as well as vertebrates ranging from pond fish, pet birds and chickens, rabbits, dogs, horses, camels, sheep and cows. The use of pollen as feed for managed honey bee colonies was identified, but rarely in commercial products due to the potential risk of spreading bee diseases. Significant quantities of frozen pollen were found necessary for the rearing of bumble bee colonies, which are marketed on an industrial scale for pollination. Bumble bee production is the only niche market where large amounts of pollen are specifically used as feed. Feed products for vertebrates tend to be generated from the same stock as pollen-based products for human consumption. This niche market is very fragmented. Any beekeeper can produce and market a pollen-based product. Only a few large specialized producers have been identified both in and outside the EU. The ratio between food and feed use of pollen is unknown in most cases. A notable exception is feed for bumble bee colonies, which may account for half of the pollen produced and imported in the EU. Products for other animals (vertebrates) are unlikely to represent more than 5% of the market. The customs classification for pollen does not allow for a clear distinction between food and feed and no statistics are being systematically stored and maintained.

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Key words: product/market survey, animal feed, pollen-based feed, pollen substitute, pollen supplements, honey bees, bumble bees

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Table of contents

Abstract		1
1.	Introduction	4
1.1.	Background	4
1.2.	Terms of Reference as provided by EFSA	4
2.	Data and Methodologies	5
3.	Product/market survey	9
3.1.	Pollen based products for bees and other animal species	9
3.1.1.	Type of pollen in the feed supply chain	9
3.1.2.	Quantity of pollen produced by location	10
3.1.3.	Pollen commodities	11
3.1.4.	Target animals	11
3.2.	Non-pollen ingredients in pollen supplements and substitutes for bees	17
4.	Conclusions	22
5.	Recommendations	22
Reference	S	24
Glossary a	and Abbreviations	28
Annex A –	Beekeeping Magazines	29
Annex B –	· Horse Magazines	30
Annex C –	Dog Magazines	31
Annex D -	- Bird Magazines	32
Annex E –	· Fish Magazines	33
Annex F –	Pollen Production in Spain	34
Annex G -	- Product information example "Candipolline Gold" for Bees	35
Annex H -	- Product information example "Carni-Poll Energy" for Horses	36
Annex I –	Product information example "Komplement L-M" for Dogs	37
Annex J –	Product information example for Shrimp	38
Annex K –	Product information example for Fish	39
Annex L –	Pollen in Trade Agreements	40

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3

EFSA Supporting publication 2021:EN-6461

1. Introduction

1.1. Background

Pollen is collected in significant quantities by wild and managed bees. It is the only natural protein source for honey bees and provides amino acids, fats, vitamins and minerals for brood rearing in the colony. Inside the hive, pollen is stored in wax cells as bee bread. Bees mix pollen with regurgitated nectar, honey and glandular secretions; with the help of microorganisms present in the honey bees stomach, the mixture is transformed via fermentation from the highly perishable freshly collected pollen into a non-perishable nutrient store of even higher nutritional value (Herbert and Shimanuki, 1978). Pollen and bee bread, also known as Perga (Milojkovic, 2018), are used to supplement both human and animal diets because of their richness and diversity of nutrients. A relatively recent but major development is the collection of pollen as feed for bumble bee production, which are used on an industrial scale as pollinators in agricultural settings as an alternative to wild pollinators or managed honey bees.

Beekeeping is an open production method. Beekeepers have limited influence over which plants bees choose as a pollen source. While the individual forager bees maximize their collection efficiency by trying to visit flowers of the same species (Klein et al., 2019), the pollen harvested by beekeepers using pollen traps is the result of the collection of many forager bees with different preferences. Depending on the landscape and the season, the vegetal origin can vary greatly (Lau et al., 2019). Experienced beekeepers will choose the location of the hive as well as the time of the collection to influence the dominant pollen types as well as to reduce the risk of contamination with potentially undesirable substances. After the collection, the beekeeper can manually remove small foreign objects (Sanford, 2003) in the collected pollen (this process does not include the removal of chemical residues, contaminants and genetically modified pollen types). Bee pollen and bee bread are being used to monitor the presence of pesticides (Tosi et al., 2018), contaminants, heavy metals (Kalbande et al., 2008) and GMOs (Hofmann et al., 2005) in the environment.

Artificial feeding¹ consists of providing honey bees colonies with either self-made or commercial products. These are either pollen supplements (pollen-based) or pollen substitutes which can be either pollen-free or have a small amount of natural pollen added to make the product more attractive to bees². Beekeepers may use artificial feeding with pollen or pollen substitutes to stimulate breeding of the brood, to encourage growth, and to promote the increase of fat body in honey bees, with the final aim of improving colony health and performance.

Commercial pollen supplements and substitutes for bees have been identified by the European Food Safety Authority (EFSA) from a quick web search (at least two products from one company with world-wide distribution), and there is also evidence that pollen-based products may be used in other animal species (e.g. racehorses), mainly as supplements of the standard diet.

To further explore on the current uses of pollen-based products in managed honey bees, a comprehensive mapping of their possible presence in the feed supply chain, both manufactured in the European Union (EU) or imported from non-EU countries to EU, is needed. Similarly, a mapping of the presence of pollen-based products for other animal species need to be explored.

1.2. Terms of Reference as provided by EFSA

The Food and Feed Working Group of the EFSA GMO Panel endorsed the launching of a product/market survey with the main purpose to overview the presence, or its likelihood, of pollen-based products for

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4

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¹ Feed material provided to bees, mainly by beekeepers, as additional nutritional source; it has become an important practice due to reduced forage from increased urbanisation, degradation of natural spaces, drought, fire and restrictions on beekeeping

 ² Pollen Substitutes and Supplements (Bulletin #411, PDF) - <u>https://www2.gov.bc.ca/gov/content/industry/agriculture-sea-food/animals-and-crops/animal-production/bees/beekeeping-bulletins</u>.

bees and other animal species in the EU and in the worldwide feed market, both manufactured in the EU or imported from non-EU countries.

The contract number PO/EFSA/GMO/2020/02 entitled "*Product/Market survey to overview the presence, or its likelihood, of pollen-based feed for bees and other animal species, in the EU feed market*" was awarded by EFSA to Walter Haefeker, Tutzinger Str. 10 82402, Seeshaupt, Germany.

The main objective of the contract PO/EFSA/GMO/2020/02 is to conduct a market survey to overview the presence of pollen-based products for bees and other animal species in the EU and worldwide feed market, both manufactured in the EU or imported from non-EU countries to EU. In addition, the aim of the survey is extended to provide an overview of products and by-products of vegetable source commonly used, as ingredients, in pollen-based and pollen-free products for bees.

The procurement consists in collecting information in a tiered approach (work packages 1 and 2).

Work package 1:

- List of pollen-based products found on the EU and worldwide market and animal species to which is intended (Task 1);
- Uses of these pollen-based products in EU and worldwide, in the beekeeping sector and in other animal species, as relevant (i.e. self-made vs. commercial) (Task 1);
- EU and worldwide market/business of pollen-based products (companies and customers) (Task 2);
- Trade within EU and into EU (Task 2).

Work package 2:

- Type of product and by-product currently used in in pollen-based and pollen-free products for bees available in the EU and worldwide market (Task 1).

2. Data and Methodologies

Because pollen and pollen substitutes are a niche market, the typical data sources for commodity products are not available. To overcome this obstacle and achieve some of the aims of the survey, a multidimensional qualitative research approach was used by looking at producers, traders, users as well as a wide range of publications from scientific papers to advertisements. The many small fragments of information obtained were organized using a digital mind mapping tool (Lin and Faste, 2011) to assemble an overview of the global market generally and the presence of pollen-based feed for bees and other animal species in the EU market specifically.

Scientific literature

The scientific literature was screened for information on pollen harvesting, production, and use. Specifically, articles discussing the role in animal nutrition were reviewed to identify additional species where a market may exist. Also, the nutritional benefits claimed and the quantities suggested in the papers were reviewed to get an indication of the market size. The literature was also used to try to obtain additional information on production quantities as well as demand in different regions.

Trade magazines (beekeeping sector)

An extensive review of the available information on pollen substitutes and supplements was conducted in the archive of beekeeping magazines maintained by the author (Table 1). Magazines have been scanned and processed with optical character recognition (OCR) over the last ten years and used to identify information beyond the scientific literature. Trade magazines were searched for articles with information for beekeepers both on pollen production methods as well as the use of feed products in

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⁵

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apiaries. The advertising sections were used to obtain examples of products offered for bee nutrition. Covers of these publications can be found in Annex A.

Publication	ISSN	Country	From	То
Abeilles et Fleurs		France	2-2015	2-2015
Bayerisches Bienen-Blatt	0724-8857	Germany	1-2016	1-2019
Bee farmer	2057-5378	United Kingdom	6-2016	6-2016
Bienen & Natur. A	2509-7008	Germany	1-2017	12-2019
Bienen & Natur. B	2509-7016	Germany	1-2017	12-2019
D.I.B. Aktuell		Germany	5-2005	4-2020
Der Buckfastimker		Germany	3-2014	3-2014
Der Thüringer Imker		Germany	3-2012	3-2012
Deutsches Bienenjournal	0943-2914	Germany	1-2011	1-2021
Gaceta del colmenar	0325-7711	Argentina	10-2015	10-2015
Gadden	1100-6951	Sweden	4-2013	12-2020
Imkerei-Technik-Magazin	0943-4534	Germany	2-2011	12-2020
Imkerfreund (München)	0019-2732	Germany	8-2010	12-2016
IMKERN heute		Austria	2-2017	2-2017
L'Apis		Italy	4-2015	4-2015
Méhészet	0465-6016	Hungary	3-2019	3-2019
Schweizerische Bienen-Zeitung (1876)	0036-7540	Switzerland	6-2006	8-2006
Svensk Biodling		Sweden	2014	2014

Table 1: Trade magazines scanned for related content

Trade Magazines (other than beekeeping sector)

Magazines were scanned for advertisements for pollen-based products. The digital subscription service Readly (<u>https://gb.readly.com</u>) provides online access to more than 5000 magazines and 130,000 issues. It was used by the author to access German, British and US magazines aimed at horse enthusiasts and pet owners. Covers of these publications can be found in Annex B - Annex E.

Trade agreements

Trade agreements between the EU and other countries have been searched for references to pollen using "pollen" as well as customs and tariff codes as search terms. (Table 2).

Table 2:Trade agreements

European Union, and South Korea, "Free Trade Agreement between the European Union and Its Member States and the Republic of Korea", 2011. <u>https://eur-lex.europa.eu/eli/dec/2011/265/oj.</u>

European Union, Columbia, and Peru, "Trade Agreement between the European Union and Its Member States and Colombia and Peru", 2013. <u>https://eur-lex.europa.eu/legal-content/en/ALL</u> /?uri=OJ:L:2012:354:TOC

European Union, and Ukraine, "Association Agreement between the European Union and the European Atomic Energy Community and Their Member States and Ukraine", 2017. <u>https://trade.ec.europa.eu/do-</u>clib/docs/2016/november/tradoc_155103.pdf

European Union, and Japan, "Economic Partnership Agreement between the European Union and Japan", 2018. <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:22018A1227(01).</u>

European Union, and Viet Nam, "Free Trade Agreement between the European Union and the Socialist Republic of Viet Nam", 2019. <u>https://eur-lex.europa.eu/legal-content/EN/TXT</u> /PDF/?uri=CELEX:22020A0612(01)&from=EN.

European Union, and United Kingdom, "EU–UK Trade and Cooperation Agreement (TCA)", 2020. <u>https://ec.eu-ropa.eu/info/sites/info/files/brexit_files/info_site/tca-20-12-28.pdf</u>

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6

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A list of trade agreements with specific treatment of pollen was retrieved using the Integrated Tariff (TARIC) and can be found in Annex L.

Customs

The Harmonized Commodity Description and Coding System (HS)³ of the World Customs Organization (WCO) (WCO, 2021) as well as the EU's 8-digit coding system Combined Nomenclature (CN) (European Union, 2021) were investigated as a potential way to identify trade activity.

There is no unique tariff classification of goods for pollen. However, the author used the Integrated Tariff (TARIC) system, which provides information on all trade policy and tariff measures that apply to specific goods in the EU, to identify pollen binding decisions. In fact, an 8-digit CN code with 2 extra digits as a TARIC subheading provides an unique identifier for pollen (1212 99 95 10), which was used to search the database of binding tariff decisions, which according to EU Regulation 952/2013⁴ the customs authorities of the member states are required to notify.

Patents

Using a search engine from Google that indexes patents and patent applications, patent filings were searched for new uses of bee-pollen or pollen substitutes as well as to gather information on methods for commercial bumble bee production.

A list of patents reviewed can be found in (Table 3).

Table 3: Patents

- Huvermann, Remco Walter, Edwin Muijt, Peter Sima, and Richard Németh, "Device for Confining Bumblebees, Use of a Laminate Material for Confining Bumblebees and Method for Confining Bumblebees", Patent Number US20140335760A1, November 13, 2014. pdf
- Koppert, Petrus Cornelis, and Remco Walter Huvermann, "Method for Feeding Social Insects and Feeding Device for Social Insects", Patent Number WO2004021773A1, March 18, 2004. pdf
- ter Horst, Gerrit Hendrik, "Improved Pollen and/or Pollen Substitute Comprising Bee Food Composition", Patent Number WO 2015/020516 Al, December 2, 2015. pdf

Vrignaud, Yves, and Michel Belin, "Feeding-Stuffs Specially Adapted for Particular Animals for Insects, e.g. Bees or Silkworms", Patent Number EP0041434A1, May 16, 1984. pdf

Vrignaud, Yves, and Michel Belin, "Pollen Substitute for Use in Apiculture", Patent Number EP0041434B1, May 16, 1984. pdf

胥保华杨维仁刘峰王颖李成成郑本乐^a, "Pollen Substitute Forage Specially for Honeybee Breeding in Spring and Preparation Method Thereof", Patent Number CN103392938A, November 20, 2013.

and Preparation Method meteor, Patent Number CN105592956A, November 20, 2015.

^a refers to a Chinese patent for which the author was not able to retrieve in the original document a related translation in Latin characters.

Associations

Beekeeping associations organised in the European Professional Beekeepers Association were asked to provide information about pollen production and their knowledge about target markets (Table 4).

³ https://www.trade.gov/harmonized-system-hs-codes

⁴ Regulation (EU) No 952/2013 of the European Parliament and of the Council of 9 October 2013 laying down the Union Customs Code https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2013:269:TOC

7

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EFSA Supporting publication 2021:EN-6461

Association	Country
Österreichischer Erwerbsimkerbund OEIB	Austria
Pancyprian Beekeepers Association	Cyprus
Danish Beekeepers Association BIAVL	Denmark
Estonian Professional Beekeepers Association EKMÜ	Estonia
Finnish Beekeeper's Association SML r.y.	Finnland
Syndicat National d'Apiculture SNA	France
Union Nationale de L'Apiculture Française UNAF	France
GDEB	Germany
German Professional Beekeepers Association DBIB	Germany
Federation of Greek Beekeepers Associations OMSE	Greece
Hungarian Beekeepers Association	Hungary
Irish Beekeepers Association	Ireland
Latvian Beekeepers' Association	Latvia
Assozjazzjoni Maltija tal-Apikultura	Malta
Polish Beekeepers Association PZP	Poland
FNAP – Portugese Beekeepers Association	Portugal
Slovak Beekeepers Association SZV	Slovakia
Slovenian Beekeepers Association CZS	Sovenia
Swedish Professional BeekeKeepers	Sweden
Swiss Beekeepers Association SVWI	Switzerlar

Table 4: European Professional Beekeeping Associations contacted

Commercial Sources

Pollen producers and resellers of pollen-based products as well as beekeeping experts were contacted and asked to provide information about the demand they are seeing for feed *versus* food (Table 5).

Two leading private laboratories specializing in bee products were contacted about the analyses they are conducting in the context of trade in pollen-based products. Both companies are used by major importers of bee products to ensure the quality of imported shipments and are very familiar with the relevant quality parameters of pollen (Table 6).

Company	Country
MegaBee	USA
Apicola Aconcagua	Chile
Badani Y Guevara Ltda.	Chile
Colliguay	Chile
Reina Kilama	Spain
Suppliers for Koppert (a)	Slovakia
Tibet Honey	China
Cum Natura GmbH	Germany
Attiki Bee Culturing	Greece
Scientific Bio Solutions	Turkey

Table 5: Producers and Resellers

(a) Group of suppliers to bumble bee production of Koppert advised by local beekeeping expert. (See Table 11)

Table 6: Private Laboratories

Country
Germany
Germany

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8

EFSA Supporting publication 2021:EN-6461

3. Product/market survey

3.1. Pollen based products for bees and other animal species

This section provides a comprehensive mapping of the presence of pollen in the feed supply chain, based on their type, quantity produced by location, target animals, and commodities.

3.1.1. Type of pollen in the feed supply chain

A comprehensive mapping of the possible presence of pollen collected by honey bees in the feed supply chain requires an understanding of the production methods as well as the different ways raw pollen can be processed and packaged for trade.

Pollen is found on the market in three forms:

- Frozen fresh pollen in the original ball or pellet formed by the bees during collection (pollen pellet);
- Dried pollen as bee-collected pollen pellet or as powder;
- Bee bread / Perga

If not dried or frozen fresh pollen will spoil very quickly (Campos et al., 2010). Frozen bee pollen has higher nutritional value than dried pollen (Anjos et al., 2019). Dried bee pollen tends to have lower microbiological contamination as compared to frozen fresh bee pollen (Anjos et al., 2019).

Due to the collection method, the pollen pellets used for frozen or dried bee pollen did not enter the colony and did not come into significant contact with substances already inside the hive. Figure 2 shows how the pollen pellets are captured as the forager bees are attempting to enter the hive.

Bee bread is different, because it is produced by the worker bees via the addition of honey and bee salivary enzymes inside the hive, where it is finally stored in wax cells and is allowed to ferment.

The fermentation process inside the hive results in a different chemical composition of bee bread compared to the pollen harvested in the pollen trap outside the colony. A comparison can be found in Table 7.



Figure 1: Pollen collection with a pollen trap



Figure 2: Bee bread (pollen stored in layers)

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9

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Component	Pollen (frozen fresh or dried)	Bee bread
Proteins	24.06 %	20.30-21.70 %
Fats	3.33 %	0.67–1.58 %
Carbohydrates	18.50 %	24.40-34.80 %
Lactic acid	0.56 %	3.06-3.20 %
pН	6.3	4.3

Table 7:	Comparison of	the chemical	composition of	pollen and b	bee bread
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Source: (Svoboda, 1940)

Bee bread is not widely available on the market (Karaman, 2019). The author could not identify any use or proposed use of bee bread as feed.

3.1.2. Quantity of pollen produced by location

No reliable quantitative data are available on global pollen production for any purpose. The FAO database on agricultural products covers the production of honey and beeswax but not pollen. In "Demographics of the European Apicultural Industry" (Chauzat et al., 2013), the authors stated that it was impossible to obtain data on the production of pollen, royal jelly, queens and packages at the EU level. This situation has not improved in the EU or the global market.

There are data available on individual countries in the EU and globally. But published data from different sources are conflicting and cannot be verified by any more than anecdotal evidence from beekeepers or beekeeping associations from the respective country. Even the fundamental data of managed honey bee colonies for each country maintained by the FAO are either official government data, which are often estimates, or statistical imputations (Hoffmeister, 2013).

Based on the estimates available to the author, the production of pollen in the EU was approximately 971 metric tons in 2010 (Chauzat et al., 2013). With 5 million colonies in EU Member States, where data are available, this translates to 0.2 kg of pollen per colony. Research estimates the annual production of pollen in China to be approximately 5000 metric tons (Zheng et al., 2011). This would be consistent with the claim that China is the largest pollen producer in the world (Yang et al., 2013). China has about 9 million managed honey bee colonies (FAOSTAT, 2018) (Tang et al., 2020). 5000 metric tons is a high but plausible value of 0.6 kg of pollen per hive. In comparison, the biggest pollen producer in the EU is Spain with 2.5 million colonies and a pollen production of 762 metric tons (Chauzat et al., 2013). This amounts to 0.3 kg of pollen per colony.

EU Member State	Number of Hives	Amount of pollen produced (in kg/Member State)	Amount of pollen produced (in kg/hive)
Spain	2.498.003	761.540	0.30
Slovakia	246.214	100.000	0.41
Hungary	995.812	100.000	0.10
Estonia	42.000	7.000	0.17
Finland	37.500	1.000	0.03
Cyprus	40.066	893	0.02
Denmark	170.000	500	0.003
Romania	963.342	100	0.001
All EU countries with data	4.992.937	971.033	0.19

Table 8: Pollen production of selected EU countries (Chauzat et al., 2

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¹⁰

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The total number of hives worldwide was 92 million in 2018 according to the FAO (FAOSTAT, 2018). Applying the production per hive from the EU countries with data, this would translate to a global pollen production of approximately 17,500 metric tons with a high degree of uncertainty.

Customs data, which contain valuable information on trade flows and implicit information on production and use, are commonly used to obtain market data. While there is a customs classification subheading for bee pollen in the EU's TARIC system, it is not consistently used, and no statistics are being compiled at this level of detail.

Even if production data were available, there would still be no information on which percentage of the production is used for pollen-based feed. The only market segment where such a correlation may be possible would be the production of frozen pollen for commercial bumble bee production.

3.1.3. Pollen commodities

Several large specialized commodity pollen producers have been identified both in the EU and overseas, but they do not collect data on the ratio between human and animal consumption as part of their normal course of business. Which batch will end up as food or feed is decided further along the supply chain. In the case of frozen pollen as feed for bumble bees are the producers sure of the ultimate use.

The German reseller "Cum Natura", who offers bee products for humans and animals (mostly pets) estimates that no more than 10% of the pollen he sells will be used for animal nutrition. For the final report it is conceivable to identify other bulk resellers, wo target both markets and may be able to provide data on the ratio.

Feed products for vertebrates tend to be created from the same stock as pollen-based products for human consumption and are derivative of them. This niche market is very fragmented. Any beekeeper can produce and market a pollen-based product. The customs classification for pollen does not distinguish between food and feed and no statistics are being systematically maintained.

3.1.4. Target animals

A distinction emerges in the market for pollen as feed for vertebrates *versus* invertebrates. The uses for invertebrates tend to mee the FAO definition of feed⁵ while uses for vertebrates meet the FOA definition of a supplement⁶ (Tacon and Hasan, 2009).

Use for vertebrates as a supplement, inspired by apitherapy, ranges from pond fish, pet birds and chickens, rabbits, dogs, horses, camels, sheep to dairy cows.

In the case of invertebrates, honey bees and bumble bees are a clear target market. There is some evidence that pollen is also being used in feed mixtures for lady beetles (Rojas et al., 2016) as well as silkworms (Moise et al., 2020). Pollen is being marketed as feed for shrimp.

Pollen production for bumble bees is the only case, where a straight line can be drawn from production to the ultimate use. All other feed products are actually commodity pollen (frozen, dried or powder) packaged and labelled for a particular use. Whether the pollen is for food or feed appears to be decided at the time of the packaging or maybe when the quality of a production batch or shipment is assessed.

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⁵ Feed(s) Material(s): Consumed by animals that contribute energy and nutrients (or both) to the diet.

⁶ Supplement: A feed used with another to improve nutritive balance of performance. It may be fed undiluted as a supplement to other feeds, offered free choice with other parts of the diet separately available, or mixed with other feed ingredients to produce a complete feed.

3.1.4.1. Pollen as feed or supplement in invertebrates

Honey bees

Careful management of the nutritional requirements is considered necessary for maintaining healthy bee colonies. During situations of pollen scarcity early in the season or in agricultural landscapes with insufficient foraging opportunities for pollen (Kremen et al., 2007) bees respond by reducing brood activity (Hellmich and Rothenbuhler, 1986).

In professional beekeeping there can be a need to achieve strong colonies through supplemental feeding to fulfil the requirements of pollination contracts or to be able to take advantage of a certain honey crop (DeGrandi-Hoffman et al., 2008).

Natural pollen is contained in some of the recipes for home-made substitutes. It is generally considered safe to use pollen and bee bread as part of feed produced within beekeeping operations. When pollen from external sources or from foreign origin is introduced into the hives, there is a risk of spreading bee diseases. Recipes frequently contain warnings about these risks.

Pollen is being used as an ingredient in only a few commercial feed products for honey bees. But it is expensive and there is the risk of disease transmission as well as pesticide contamination. Some producers claim on the ingredient list, that pollen was irradiated or sterilized. Most commercial products use other protein sources and are often advertised as "pollen-free".

This survey covers both pollen and pollen-substitutes. The list of ingredients on the packaging as well as the information provided on marketing materials of the manufacturers (e.g. brochures, datasheets) cannot be unreservedly relied upon to be sure of the actual contents of the products. There is no routine laboratory analysis throughout the supply chain of feed products to the beekeepers. Independent laboratory analysis to verify the composition of the products listed in this report was not conducted and would be out of the scope of the survey.

The following table covers only products aimed for use in the beekeeping sector. These products contain natural bee pollen according to the ingredient list or information from beekeeping experts familiar with the product.

Pollen substitutes will be discussed separately in Section 3.2.

Manufacturer		Product		
Name	Country	Name	Composition ^(a)	
Anel	Greece	троф'н Вал'іліа Ме Г'үрн	Contains pollen as well as sugar and water 1:4 with the addition of one teaspoon of lemon juice for every 4kg of sugar. ^(b)	
Enolapi	Italy	Candipolline Gold	Beet Sugar (Sucrose), Sugar Syrup, Pollen, Caseinate, Albumen, Glycerine	
Global Patties	Canada	Standard 4% Pollen Patty	Sugar, Soy, Yeast, Water, Latshaw's Vitamin & Mineral Supplement ^(c) , 4% Pollen	
Global Patties	Canada	Standard 15% Pollen Patty	Sugar, Soy, Yeast, Water, Latshaw's Vitamin & Mineral Supplement ^(c) , 15% Pollen	
Imkereibedarf Bährle	Germany	Neopoll N	Total sugar content 87,2% (calculated as sucrose) Protein: 0,3%, fat: 0.3%, fibers: 0.3%, ash: 0.01% Pollen: 100% German flower pollen	
Imkereibedarf Bährle	Germany	Neopoll C	Same as Neopoll N, but additional supplements.	
Imkereibedarf Bährle	Germany	Neopoll Königin	Modified for queen breeding. Contains German flower pollen.	

Table 9:	List of pollen-based	products intended	for honey bees
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www.efsa.europa.eu/publications

12

EFSA Supporting publication 2021:EN-6461

Manufacturer		Product	
Name	Country	Name	Composition ^(a)
Lyson	Poland	Apikand with Pollen	Dextrose 50%, Fructose 38%, Pollen 8%, Triose 2%, Maltose 2%

(a) Ingredients as stated by the manufacturer. Not independently verified.

(b) Ingredients as stated by local beekeeping experts. Not independently verified.

(c) Provided by Latshaw Apiaries, Alexandria, Ohio, USA

Bumble bees

Significant quantities of frozen pollen are required in the rearing of bumble bee colonies, which are marketed on an industrial scale for pollination (Velthuis and van Doorn, 2006). Bumble bee production is the only niche market, where large amounts of pollen are specifically produced as feed, which may account for half of the pollen produced and imported in the EU. Only 100% natural bee pollen is used to rear bumble bee colonies.

It has been shown that honey bee viruses can be transferred to to bumble bees via pollen (Singh et al., 2010). This is especially true for frozen pollen (the virus remains infectious in the pollen).

The USA and Canada prohibit the importation of pollen as bee feed. But there is a lack of enforcement preventing the diversion of pollen legally imported for human consumption as bee feed. In Mexico, there are regulations that allow bee producers to import irradiated pollen from certain countries (e.g., Spain and Canada) for use as bee feed (Cameron et al., 2011).

Some pollen substitutes used for honey bees have been investigated because of potential cost savings and reduced the risk of contamination. (Bortolotti et al., 2020) This research is very recent and does not appear to have implemented commercially. For the short term the main protein source in bumble bee rearing operations is likely to remain bee collected pollen.

Species	Subspecies	Origin	Used in	Source (Com- pany)
Subgenus <i>Bombus</i>				
B. terrestris L.				
	<i>B. t. audax</i> (Harris 1780)	Belgium	U.K. only	Biobest
	<i>B. t. canar- iensis</i> Pérez	Canary Islands	Canary Islands	Biobest
	<i>B. t. dalmatinus</i> Dalla Torre	south-eastern Europe, Tur- key	Europe	Koppert
	<i>B. t. Sassari- cus</i> Tournier	Sardinia		Koppert
	B. t. Terrestris L.	Europe, Tur- key, North Af- rica, China	Europe, North Africa, Asia, Australasia and Chile	Biobest, Koppert

Table 10: List of species and subspecies of *Bombus* commercially reared with pollen-based feed:

 (Owen, 2016)

www.efsa.europa.eu/publications

13

EFSA Supporting publication 2021:EN-6461

Species	Subspecies	Origin	Used in	Source (Com- pany)
B. lucorum L.		Europe, Asia	East Asia	
B. ignatius		Belgium	Japan only	Biobest
B. occidentalis		Western North America	Western North Amer- ica	
Subgenus Pyrobombus				
B. impatiens		Canada, Mex- ico	North, Central and South America	Biobest, Koppert, Green Methods
Subgenus <i>Fervidobom-</i> <i>bus</i>				
B. atratus		Argentina	South America	Biobest

In 2006, a list of commercial bumble bee breeders was published (Velthuis and van Doorn, 2006). Since then, significant consolidation has taken place in the sector. Table 11 shows the leading companies in this sector. None of the companies are publicly traded. Therefore, no information on sales and market share are available. The scale of commercial bumble bee production and global distribution has reached a point where concerns are being raised about a threat to local bumble bee populations (Graystock et al., 2013, 2016; Seabra et al., 2019).

Manufacturer		Products
Name	Country	Website
Koppert Biological Systems	The Netherlands	https://www.koppert.com/challenges/boost-your-pollination/
Biobest Group NV	Belgium	https://www.biobestgroup.com/en/biobest/products/bumblebee-polli- nation-4460/
Biopol Natural	The Netherlands	https://biopol.nl/pollination.html
Agrobio	Spain	https://www.agrobio.es/information/bumblebees-and-pollina- tion/?lang=en

Table 11: List of commercial enterprises currently engaged in bumble bee production

The sales of commercial bumble bee colonies were estimated to be one million in 2004 (Velthuis and van Doorn, 2006). This number had doubled ten years later (Graystock et al., 2016). The nutrition requirement is estimated to be 176 g of pollen per colony (Rotheray et al., 2017). At 2016 levels, the pollen requirements of this industry would be 352 metric tons assuming perfect utilization and zero waste, but more likely the amount is 500 metric tons (Graystock et al., 2016).

Table 12:	List of pollen-based	products intended	for bumble bees
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Manufacturer		Product	
Name	Country	Product	Destination(s)
Badani Y Guevara Ltda.	Chile	Frozen pollen	Bumble bee production in EU and, Mexico
Lorenzo Molina, Colliguay	Chile	Frozen pollen	TBC
Apícola Aconcagua Ltd	Chile	Frozen pollen	TBC
www.efsa.europa.eu/publications		14	EFSA Supporting publication 2021:EN-6461

Manufacturer		Product	
Multiple Beekeepers (a)	Hungary	Frozen pollen	Bumble bee production in Slovakia
Multiple Beekeepers (a)	Slovakia	Frozen pollen	Domestic pollen production for bumble bee rear- ing in the same country

TBC: to be confirmed

(a) Information provided by beekeeping association (e.g. Orszagos Magyar Meheszeti Egyesület, Slovenský zväz včelárov).

Shrimp

Pollen is being marketed as feed for young shrimp reared in aquarium.

An example for a commercial product is provided in Annex J. A report prepared in 1987 for the FAO covering regional aquaculture activities for Latin America and the Caribbean is listing bee pollen as a possible nutrient for shrimp farming (Tacon, 1987).

Silkworms (Bombyx Mori)

One research paper describes the use of bee pollen as part of an artificial diet in sericulture (Moise et al., 2020). Because of the growing interest in insects as a protein source for food and feed as well as the possibility to produce both fiber and protein using silkworms, bee pollen may play a role in this area in the future.

Lady beetle (Coleomegilla maculata)

A mix diet consisting of *Ephestia kuehniella* and *Artemia* sp. eggs, and bee pollen was described as a control in a paper investigating another ingredient (Rojas et al., 2016). This suggests that bee pollen may play a role as feed for the rearing of beneficial insects.

3.1.4.2. Pollen as feed or supplement in vertebrates

Horses

Several commercial products are specifically designed for horses, for apitherapy as well as for enhancing performance for racehorses. An example is provided in Annex H. Recent research appears to support the claimed benefits (Turner et al., 2006; Kędzierski et al., 2020).

Manufacturer		Product	
Name	Country	Name	Composition ^(a)
Atcom	Germany	Sanabol	Brewer's yeast, dextrose, flower pollen, linseed oil, micro algae, magnesium fumarate, aniseed, fennel, garlic, fenugreek seeds, liquorice root, caraway, Ice- landic moss, ribwort herb, peppermint, marshmallow root, mallow blossoms, black cumin, thyme, sage leaves, lime blossoms, spruce shoots, eucalyptus leaves, primrose, elderflower
Eifelwiese ^(a)	Germany	EquiBasal	Apple granules, sunflower lecithin (GMO-free), rose hip, grape seed flour, brewer's yeast, nettle, spir- ulina, seaweed, flower pollen, aniseed, caraway, fennel
Kräuterhaus Gülpen	Germany	PollenPowerMix	25% Pollen

www.efsa.europa.eu/publications

15

EFSA Supporting publication 2021:EN-6461

Manufacturer		Product		
Name	Country	Name	Composition ^(a)	
Lexa	Germany	LEXA Ergänzungs- futter IMMUN-AKTI- VATOR	yeast, dextrose, linseed expeller fine flour, brewer's yeast, sugar beet molasses, lucerne meal, vegetable fat (rape/coconut), flower pollen, sprayed whey powder, Echinaceae, linseed oil, magnesium fumarate, rose hips, black cumin oil, garlic, micro al- gae, cinnamon bark, sea buckthorn, calcium car- bonate	
Horeseremedy	Belgium	Bee pollen for	Bee pollen	

(a) Ingredients as stated by the manufacturer. Not independently verified.

Camels

One of the products offered for horses also stated that it may be used for racing camels (Royal Ilac, 2019).

Dogs

The use of pollen as a treatment for dogs in traditional Chinese medicine was discussed in a paper providing an overview of the use of bee pollen in apitherapy while arguing for the need for standards and methodologies to ensure high quality for pollen produced for therapeutic purposes (Campos et al, 2010).

The authors of the paper refer to a bee pollen treatment, which was administered by Chinese researchers to aged dogs with prostatic hyperplasia over a period of two months. Reduced prostate size was observed both at one and at two months (Lin et al., 1990). An example for a commercial product containing pollen for dogs is shown in Annex I.

Manufacturer Product		Product	
Name	Country	Name	Composition ^(a)
Zoobedarf Hitzegrad	Germany	Blütenpollen	Bee pollen
PerNaturam	Germany	Komplement für Hunde	Rapeseed lecithin (GMO-free), silica, seaweed meal, brewer's yeast (total vitamin B complex), ground flower pollen, spirulina (chlorophyll, magnesium), concentrates of Brazil nuts (selenium), cod liver oil (supplier of vitamin D, omega-3 and omega-6 fatty acids), rose hip peel (supplier of vitamin C, vitamin K and beta-carotene)
PerNaturam	Germany	Komplement L-M	Sunflower lecithin (GMO-free), brewer's yeast (total vitamin B complex), seaweed meal (minerals and trace elements), ground flower pollen (all amino ac- ids), spirulina (chlorophyll, magnesium), grape seed flour, cranberry powder, rose hip peel (supplier of vit- amins C, K and beta-carotene) and cod liver oil (sup- plier of vitamin D, omega-3 and omega-6 fatty acids). All substances are of natural origin.

Table 14: List of pollen-based products found on the EU and worldwide market intended for dogs

(a) Ingredients as stated by manufacturer. Not independently verified.

www.efsa.europa.eu/publications

16

EFSA Supporting publication 2021:EN-6461

Rabbits

No commercial products specifically aimed at this market could be identified, but the use of pollen for rabbits has been investigated (Attia et al., 2019).

Chickens

The effect of bee pollen on growth performance, intestinal morphometry and immune status of broiler chickens was reported in the literature (Fazayeli-Rad et al., 2015).

Trophic effect of bee pollen on small intestine in broiler chickens was studied. Bee pollen could promote the early development of the digestive system and therefore was found to be a potentially beneficial food supplement for certain conditions, such as short bowel syndrome (Wang et al., 2007). Researchers found that bee pollen has positive effect on the growth of male chicken in terms of increasing the body weight, whereas it has negative effect on the female chickens (Peter et al., 2012).

Sheep

The effect of pollen on the performance of rams was investigated (Taghian et al., 2017). In this case Lactic acid fermentation of pollen by Lactobacillus bulgaricus and Streptococcus thermophiles was used to produce artificial bee bread. This process emulates the fermentation of pollen inside the hive used by honey bees for storage (Krell, 1996).

Cows

For pre-ruminant calf nutrition, pollen can be used as a supplement and milk replacers (Tomkins and Jaster, 1991). It was shown that that a dietary supplementation with bee pollen improved nutrient digestibility in pre-ruminant calves (Tu et al., 2015).

Fish

Pollen is being marketed as feed supplement for pond fish. An example for a commercial product is provided in Annex J.

3.2. Non-pollen ingredients in pollen supplements and substitutes for bees

Because of the cost of bee pollen and also the potential risk of spreading bee diseases, feed products for honey bees use pollen substitutes, which are in almost all cases pollen-free or may have a small amount of natural pollen added to make the product more attractive to bees.

Some recipes for preparing bee feed that is both effective and inexpensive are in the public domain and shared in textbooks (Abbot, 1881) as well as magazine articles for beekeepers (Oliver, 2015). A list of commonly used ingedients can be found in Table 15.

Ingredient	Reference and additional infor	mation
Barley flour	Oliver, 2013	
Brewers Yeast	Oliver, 2013	
Chick pea (Cicer arietinum L.)	Sihag and Gupta, 2011	
Corn gluten	Oliver, 2013	
Egg or egg yolk - dried	The albumen in eggs contains avid unavailable to the developing larva	lin, a protein that binds biotin and makes it a. Oliver, 2013; Wardell, 2020
Lupin flour	Somerville 2005	
Mung bean (Vigna radiata)	Sihag and Gupta, 2011	
www.efsa.eurona.eu/nublications	17	EESA Supporting publication 2021 EN-6461

www.efsa.europa.eu/publications

EFSA Supporting publication 2021:EN-6461

Ingredient	Reference and additional information
Oliver, 2013	Oliver, 2013
Pigeon pea (Cajanus cajan)	Sihag and Gupta, 2011
Poultry blood - spray dried	Burlew, 2018
Quinoa flour	Oliver, 2013
Soy flour	Haydak and Tanquary, 1943. Two main sugars [Raffinose Stachyose] are toxic to honey bees. Trypsin inhibitor if not toasted. Oliver, 2015
Soy protein isolate	Oliver, 2013
Torula yeast	Somerville 2005

A wide variety of formulations are being offered commercially. In many cases, the composition is considered to be a trade secret. Some vendors even offer production on demand, according to the customers specifications.

Some scientific studies have been published on the effectiveness of pollen substitutes compared to natural pollen. In these papers, the exact composition of the products being investigated is not stated (De Jong et al., 2009; Saffari et al., 2004). Table 16 provides a list of pollen-free products intended for honey bees. The information about the ingredients was obtained from the marketing materials of the respective manufacturer and was not independently verified by the author.

Manufacturer		Product	
Name	Country	Name	Composition ^(a)
Advance Science	Ireland	Hive Alive	HiveAliveTM uses natural active ingredients, in particular a proprietary blend of seaweed extracts, and is available world- wide. HiveAliveTM is HACCP controlled, its ingredients and process are EU approved, and the ingredients are gener- ally regarded as safe (GRAS) establishing a high level of protection for animals and humans. (Charistos et al., 2015)
Alltech	Spain	Bee Pollen- Ate	Its unique formula is built on yeast technology that has been perfected and quality proven over 37 years.
Alltech		BEE-SACC	The base of BEE-SACC is a specific strain of Saccharomyces Cerevisiae strain 1026, which provides a high level of easily assimilated protein with a profile very similar to that of pollen.
ANEL	Greece	Soy (Raw Material)	Low fat soya powder, suitable for beekeeping use.
ANEL	Greece	Pollen Substi- tute 450 gr	Protein.
Apinor	Norway	Apifor	Contents: Sugar, heat treated soybean flour, inert brewer's yeast, egg powder, wheat gluten, vegetable oil, lactic acid and ascorbic acid. Vitamins :A, B1, B2, B6, D, E, K, choline, niacin pantothenic acid, folic acid, C and biotin. Minerals: iron, calcium, sodium, potassium, magnesium, phos- phorus, zinc and selenium. All raw materials are approved for the production of animal feed.
Apitec	Greece	BEEngo	A bee-feed with protein, ideal for the stimulation of the bees and substitute for pollen. Contains inactive brewer's yeast.
Apitec	Greece	APIzyme	A bee-feed with 33% invert sugar and 67% sugar. On request it is available with garlic or with thymol for better disease con- trol and with protein for the better brood's development.

www.efsa.europa.eu/publications

EFSA Supporting publication 2021:EN-6461

Manufacturer		Product		
Name	Country	Name	Composition ^(a)	
Apitec	Greece	CANDYdust	A powdered sugar from sugar beet, which is used in the man- ufacturing of the Beengo. A sugar with protein suitable for the development of the bees.	
Feedbee	Canada	Feedbee	Ingredients: Feedbee is made from 100% processed plant materials. Feedbee is made from 100% Canadian materials Feedbee is free from: Pollen Hive Products Animal Products/by-product Soy products/by-products Genetically Modified Organism Chemicals Antibiotics/Medicines Artificial Colours, Flavours or Preservatives (Rasha et al., 2018)	
Global Patties	Canada	Standard Pro- tein Patty	Sugar, Soy, Water & Yeast - No Pollen	
ICKO Apiculture	France	Api Pollen	Ingredients: soya and yeast proteins (76%); vitamins: B1, B2, B6, B12, PP, C, A, D3, E (8%); mineral complex (4%); vegetable fats (7%); essential plant oils (2%); cinnamon and other antioxidants (0.8%); probiotics (0.2%); excipients (2%).	
Latshaw Apiaries	USA	Latshaw's Vit- amin & Min- eral Supple- ment	Latshaw's Vitamin & Mineral Supplement is formulated as a dry powder and contains approximately 30 balanced nutrients.	
Mann Lake	UK	Ultra Bee Dry	Ingredients: Plant Protein Products, Processed Grain By-Prod- ucts, Roughage Products, Canola Oil, Lemongrass Oil, Sodium Chloride, Vitamin A Supplement, Vitamin D3 Supplement, Vita- min E Supplement, Ascorbic Acid Stabilized, Zinc Sulfate Mon- ohydrate, Menadione Sodium Bisulfite Complex, Riboflavin, Pyridoxine Hydrochloride, Folic Acid, Biotin	
Mann Lake	UK	Ultra Bee Patty	Ingredients: Plant Protein Products, Fructose, Processed Grain By-Products, Dextrose, Sugar, Water, Canola Oil, Shortening (Palm Oil and Soybean Oil with Mono- and Diglycerides and Polysorbate 60 added. TBHQ and Citric Acid added to help protect flavor), Citric Acid, Lemongrass Oil, Spearmint Oil, Roughage Products, Lecithin, Thymol, Sodium Chloride, Vita- min A Supplement, Vitamin D3 Supplement, Vitamin E Supple- ment, Ascorbic Acid Stabilized, Zinc Sulfate Monohydrate, Menadione Sodium Bisulfite Complex, Riboflavin, Pyridoxine Hydrochloride, Folic Acid, Biotin	
Mann Lake	UK	Bee-Pro Dry	Ingredients: Plant Protein Products, Roughage Products, So- dium Chloride, Vitamin A Supplement, Vitamin D3 Supple- ment, Vitamin E Supplement, Ascorbic Acid Stabilized, Zinc Sulfate Monohydrate, Menadione Sodium Bisulfite Complex, Riboflavin, Pyridoxine Hydrochloride, Folic Acid, Biotin	
Mann Lake	UK	Bee-Pro Pat- ties+	Ingredients: Sugar, Plant Protein Products, Fructose, Dex- trose, Water, Canola Oil, Vegetable Shortening, Roughage Products, Citric Acid, Spearmint Oil, Lemongrass Oil, Lecithin, Thymol, Sodium Chloride, Vitamin A Supplement, Vitamin D3 Supplement, Vitamin E Supplement, Ascorbic Acid Stabilized, Zinc Sulfate Monohydrate, Menadione Sodium Bisulfite Com- plex, Riboflavin, Pyridoxine Hydrochloride, Folic Acid, Biotin	

www.efsa.europa.eu/publications

19

EFSA Supporting publication 2021:EN-6461

Manufacturer		Product	
Name	Country	Name	Composition ^(a)
Mega Bee	USA	Mega Bee	Contains no animal byproducts.
Mass Das		Powder MagaPag Dat	Contains all 10 essentail amino acids in their proper ratios.
меда вее	USA	ties	n/a
Mieles Llovell	Spain	Beecomplet spring	Apicomplet Beecomplet is a flower nectar. All nutrients are 100% vegetable. It does not contain pollen, preservatives or additives of industrial origin (antibiotic proteins etc.)
Mieles Llovell	Spain	Beecomplet autumn	In Beecomplet autumn we have increased the sugar and low- ered the water, keeping the vegetables (which are the ones that provide the nutrients)
Mieles Llovell	Spain	Beecomplet with plants acaricides	Apicomplet Beecomplet is a flower nectar. All nutrients are 100% vegetable. It does not contain pollen, preservatives or additives of industrial origin (antibiotic proteins etc.)
Pender Bee- keeping Supplies	Australia	Bee Build Protein Sau- sage	Substitute – no ingredient list available.
Pender Bee- keeping Supplies		Irradiated pollen	Pollen from Jarrah (Eucalyptus marginata) collected in West- ern Australia.
Purina	USA	Hearty Bee	Spray dried poultry blood. (Burlew, 2018)
Vita Europe	UK	VitaFeed Power	Hydrolysed vegetable proteins (source of DL-methionine, gly- cine, tyrosine, arginine, histidine, isoleucine, leucine, lysine, valine, threonine and tryptophan), Dextrose.
Vita Europe	UK	VitaFeed Patty	Ingredients: Yeast products (Saccharomyces cerevisiae), Fruc- tose, Beet sugar (sucrose), Dextrose, Com 0", Vegetable fat. Vitamins: A, D3, K3, B1, 82, B12. Biotin, Niacinamide, Cal- cium D-Pantothenate, Inositol, Zinc, Aromatic substances, Po- tassium sorbate.
Zukán Apícola	Spain	Apipasta Plus	Carbohydrates are provided by a sugar paste which gives the product a texture adequate for gradual consumption. Finally and in a lower amount, Apipasta® Plus contains a small per- centage of vegetable fat. Apipasta® Plus contains the micro- nutrients present in pollen in similar concentrations, such as vitamins of the B group (Bl, B2, B3, BSy 86), C, K and A and minerals such as Ca, Na, Se, Zn and P.
Zukán Apícola	Spain	Apipasta Bio	n/a
Zukán Apícola	Spain	Apipasta Vit- amins	n/a
Zukán Apícola	Spain	Apipasta	Possibility of adding vitamins and proteins to the product. Tailor-made to the specific needs of migratory beekeeping.
Zukán Apícola	Spain	Apimix	Liquid syrup with high fructose content, one of the most val- ued sugars by bees It contains high levels of vitamins, pro- teins and essential amino acids, which are necessary to stimu- late the beehive brood.
Tony Lalonde Sales	Canada	TLS Bee Food	n/a

n/a no information available

(a) Ingredients as stated by manufacturer. Not independently verified.

There are no overall market data. Anecdotal evidence was obtained from resellers and beekeeping experts. In Northern European countries, 80% of the pollen substitute products are going to part-time

EFSA Supporting publication 2021:EN-6461

beekeepers and only 20% to full-time professionals. In Southern Europe as well as North and South America, there is intensive use of these products by large professional beekeeping operations.

No specific customs code for bee feed was found. However, an import document available to the author for the Canadian product FeedBee into the EU uses the tariff number "230 80000" which refers to the HS code 2308 "Vegetable materials and vegetable waste, vegetable residues and by-products, whether or not in the form of pellets, of a kind used in animal feeding, not elsewhere specified or included".

www.efsa.europa.eu/publications

21

EFSA Supporting publication 2021:EN-6461

4. Conclusions

The survey shows that pollen plays only a niche role in the nutrition of vertebrates used as pets or livestock. The use in feed for invertebrates is limited to insects. The market is quite extensive for bumble bees and to a lesser extent to honey bees. The use for lady bugs and silkworms has been described, but no data was found on the actual commercial use.

The only worldwide market where a direct connection between production and use for a specific species could be found is the production of bumble bee colonies for pollination. Anecdotal evidence suggests that the demand for pollen in this sector may be higher than for all the other uses.

It is conceivable that pollen as feed for beneficial insects could become more important in the future. The production of large quantities of predators and pollinators in agriculture, for pest control and pollination, as well as a shift to insect protein as food and feed for humans and livestock may create additional demand for pollen-based feed.

All forms of pollen (i.e. freshly collected in pollen traps, stored and processed in the hive as beebread and fresh, dried or frozen) may contain pesticide residues. This is particularly true in the case of pollenbased feed for insects. Species raised on pollen obviously may not develop well in the presence of residues from chemical insecticides as well as pollen from modified plants to express toxins (Stanley and Raine, 2017).

Due to the high cost of bee pollen as well as the risk of contamination with bee infectious agents and pesticides, the beekeeping sector has developed a wide range of pollen substitutes. Basic recipes are in the public domain allowing beekeepers to prepare their own feed. There is a significant market for commercial products. Information about the composition of pollen substitutes on the labels is frequently incomplete and not independently verified.

Bee feed is placed inside the hive where it can come in direct contact with the honey and become a source of contamination of food intended for animal and human consumption. In the case of feed for farm animals, there is an assumption, that most ingredients are metabolized and do not end up in the final food product.

The commercial products which are being offered for pets originate from food supplements for human consumption. The claimed benefits for animal health are based on the long tradition of apitherapy. Horses, for recreational use, appear to represent a significant niche market for products containing bee pollen.

For several livestock animals, the benefits of pollen used as feed are being investigated. However, at this stage no commercial product could be identified, but the most likely use would be in the form of bulk dried pollen, which is available on the worldwide market.

5. Recommendations

Given the increasing demand for the use of pollinators in agroecosystems, in particular with bumble bee colonies (Breeze et al., 2014), a more systematic monitoring of this type of production in and outside EU would reinforce its traceability. More broadly, the traceability of pollen production, trade and use in EU could be reinforced with a more systematic use of a specific code (e.g. customs classification consisting of the 8-digit CN code with 2 extra digits as the TARIC subheading)

The supply of high-quality low pesticide residue pollen as a feed source for pollinator production needs to be assuered. This may become more significant as additional feed supplement requirements arise from the commercial production of other beneficial insects as well as insects as a protein source (EFSA Scientific Committee, 2015).

www.efsa.europa.eu/publications

22

EFSA Supporting publication 2021:EN-6461

A survey of pollen and pollen substitutes involving market sampling and laboratory analysis would allow a closer monitoring and control of the accuracy of the information provided by the manufacturers for bee feed placed on the market in the EU.

www.efsa.europa.eu/publications

23

EFSA Supporting publication 2021:EN-6461

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24

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25

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26

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27

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Glossary and Abbreviations

Glossary:	
Apitherapy	A branch of alternative medicine that uses honey bee products, including honey, pollen, propolis, royal jelly and bee venom.
Perga/Bee bread	Pollen collected by honey bees and preserved by the addition of honey and bee salivary enzymes inside the bee hive.
Pollen-based	For the purposes of this report, pollen-based refers to products, which either use pollen as a significant ingredient by weight or volume or rely on some amount of pollen as a differentiating factor.
Pollen-free	Refers to products which a specific claim to contain little or no pollen.
Pollen substitutes	Refers to products designed to replace all or a substantial part of the natural pollen otherwise needed to feed bees. Pollen substitutes can be either pollen-free or have a small amount of natural pollen added to make the product more attractive to bees.
Pollen supplements	refers to products which meet the FAO definition of a supplement - A feed used with another to improve nutritive balance of performance. It may be fed undiluted as a supplement to other feeds, offered free choice with other parts of the diet separately available, or mixed with other feed ingredients to produce a complete feed.
Preruminant	a stage in the development of ruminants, where the rumen doesn't yet function. Some feeds that mature cows can digest, calves can not.

Abbreviations:	
BTI	Binding Tariff Information
CN	Combined Nomenclature
ANSES	French Agency for Food, Environmental and Occupational Health & Safety
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration (United States)
HS	Harmonized Commodity Description and Coding System
TARIC	Integrated Tariff
WCO	World Customs Organisation

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28

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Annex A – Beekeeping Magazines

























Der Thüringer Imker



Bienen-Zeitung



















Imkerfreund (München)



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29

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Annex B – Horse Magazines











Midland Horse: East Midlands



















PferdeWoche



















Horse & Countryside



Quarter Horse Journal















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30

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Annex C – Dog Magazines

















1







AMER

Our Dogs Crufts and International Winners













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31

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Annex D – Bird Magazines























2397825, 2021, 2, Downloaded from https://efia.onlinelibrary.wiley.com/doi/10.2903/sp.efia.2021.EN-6461, Wiley Online Library on [06/03/2023]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

32

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Annex E – Fish Magazines











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33

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Annex F – Pollen Production in Spain









Pollen samples (Photo: Karl-Rainer KOCH

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34

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Annex G – Product information example "Candipolline Gold" for Bees

biregister

) kallelsen till i Gadden 4-16. 'ån BF, SLU, SBR, Länsande via Magnus Gröntoft.

till alla som har bin i området med ett varningsmeddelande om amerikansk yngelröta. Med ny teknik går det att få ut info inom ett par timmar. BFs officiella inställning iden är att har som ele in i

idag är att det som ska in i registret är det som är krav i lagen idag, det vill såga inte antal samhällen. Det ska vara sekretess på register. Man bör använda sig av CDB-erfarenheter angående snabb information vitt utbrott av sjukdom. Bra med en morot, t.ex. som England – Drev om bihålsa. Det som gäller den egna biodilingen bör ligga på privat dator, och sedan kommunicera

det som behövs till registret. Det som gäller år koordinater. EF kommer att föja lagen, men kommer inte att lämna fler uppgifter än vad lagen kräver. Det är bättre att lägga mer vikt på egenkontroll. Det finns oro att genom registretringen kommer att läggas med krav på biodlare, samt hur registret ska vara tillgänglig. Det är orinnigt att bitillsynsmän är biodlare och i många fall konkurrenade biodlare. Rädsa finns för jäviga bitillsynsmän och konkurrens-

man är biodlare och i många fäll lonkurrennde biodlare. Rädsla finns för jäviga bitillsynsmän och konkurrens. Yrkesmässiga biodlare konkurrerar med hobbybiodlare. samma krav ställs inte på de olika. Använd anställda biinspektörer i Sverige, använd dagens pengar till tillsynen för att anställa dem. Mer om detta på konferensen.

CANDIPOLLI

ENOLAPI .

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Best before: 18.04.2018

ENOLOGIA

ANDIPOLLINE

APICOLTURA

um 45 mg/kg, <LQ, Lysine <LQ

Batch. G181016







Enolapi srl	Lauzelle - 33
Via Torricelli, 69/a 37136 Verona - Italy tel: +39 45 95 50 21 e-mail: enologi@gmail.com www.enolopi.it	
Enalga has being operating for over. 60 years is to products ordenia and "Cantigonian Gold. Protonectar and "Cantigonian Gold. Be poline (setting with gamma ray to avoid any co paretect bee-freeding product. With the connected bee-fram "Campo dei Flori", sp Rigustica) and a selection of plants and seeds that when the second bee-fram "Campo dei Flori", sp Rigustica) and a selection of plants and seeds that when the second bee-fram "Campo dei Flori", sp Rigustica) and a selection of plants and second the second bee-fram "Campo dei Flori", sp Rigustica) and selection de plants and second beer second beer second beer policita comme Campolita, Plants and second that of the poline nature (definite per rayon gamma afin div Avee "Campo dei Flori", la secietà se specialita de Avee "Campo dei Flori", la secietà se specialita del galantica) at una selection de plantes at de ganans	entenping and beekeeping equipment. Located in Veronn, Italy, sells far lang production of the value with products like of the antibiotism intermination with any desense), sugger and velocities like of the perfect exclusion with any desense), sugger and velocities (and the perfect exclusion in the any desense), sugger and velocities (apis mellifier and particular interest for back-keeping). International and the perfect of the second state of the second lesion and the perfect of the second state of the second lesion and the second state of the second state of the second lesion and the second state of the second state of the second lesion and discond states and the second state of the second lesion and discond states and the second state of the second lesion and discond states and the second state of the second relation and discond states and the second states and the second relation and the second states and the second states and the second relation and the second states and the second states and the second relation and the second states and the second states and the second relation and the second states and the second states and the relation and the second states and t
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Hauptstrasse, 67 77728 Oppenau - Allemagne	55-10-22 + B
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35

EFSA Supporting publication 2021:EN-6461

Annex H – Product information example "Carni-Poll Energy" for Horses



Carni-Poll Energy

"Pollen and carnitine will become the horses stronger"



Indication: Carnitine, which is scientifically proven positive impact on the energy metabolism, is a race and workout support product for the horses involving bee's pollen, promoting the use of energy in the cells, increasing the durability and trimetilglycine. Also the B12 vitamin that the product contains, supports liver functions and promote blood construction.

Composition: Vitamin B12: 20 mg, Bee polen: 25%, L-Carnitine: 16,66%, Sorbitol: 16,66%, TrimetilGlycin: 13,33%, Honey, Fructose and other nutritionals Please see label for complete composition.

Feeding Instruction: Royal Horse Carni-Poll should be started to give one syringe 2 days before the race once a day and the last dosage should be given in the morning of the race or 2-4 hours before the race starts. It is recommended totally 3 dosages during 3 days. It is not recommended that given more than one time in a day.

Endurance: Apart from the races, given 3 times the product in a month is contributed a positive forperformance and increasing the resistance.

Royal Horse Carni-Poll does not contain any prohibited substances in the races.

EnergyMax Pre-race

"The energy will remain stable."

Indication: Hypoglycaemia in the races and training causes performance decrease.

To avoid this, EnegyMax Pre-race content:

- The part mix with blood easily contains the enzyme hydrolysed energy source.
- B vitamins are effective in lactic acid control and power transfer, carrying out the metabolic functions.
- Amino acids support the protein and enzyme metabolism.
- It supports the resistance of the camel and energises it a long time.
- Carnitine, betaine, ginseng extract: have an impact the performance stimulating energy consumption in cells.

Composition: Vitamin B1: 1.500 mg, Vitamin B2: 1.050 mg, Vitamin B3: 12.000 mg, Vitamin B5: 750 mg, Vitamin B6: 300 mg, Vitamin B12: 40 mg, Betain: %1,5, Gliycin: %4, L Carnitine: 7.500 mg, L-Lysin: 1,4%, Methionin:

7,5%, Glutamic acid: 5%, Leucine:2,4%, Sorbitol: 10%, Fructose, Sucrose, Dextrose, Enzyme partial hydrolysate of starch: 10%, Korean Ginseng (Kore Ginsengi): 1.500 mg

Feeding Instruction: 1 day before the race: 1 sygringe, 2 hours before the race: 1 sygringe.

1 more syringe can be given with the aim to the provide strength and resistance.

It is not recommended more than 3 sygringes per day.

EnergyMax Pre-Race does not contain any prohibited substances in the races.



36







Annex I – Product information example "Komplement L-M" for Dogs



Home > Hunde > Visceralien - innere Organe > Herz & Nieren > Komplement L-M



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37

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Annex J – **Product information example for Shrimp**

AN FARM OAL					
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PATURAL PRODUCT					
	ies 🗸	HOME	SHOP	INFORMATION	

Home / Brand / Borneowild / BorneoWild Bee Pollen 50gr



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38

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Annex K – Product information example for Fish

Startseite > Blütenpollen für Kois > Blütenpollen für Kois





Blütenpollen sind der perfekte Futterzusatz für Ihre Kois!

Durch die Blütenpollen wird sichergestellt, dass es Ihren Kois in der täglichen Kost an keinen Nähr- und Vitalstoffen mangelt.

Tun Sie Ihren Kois also gerade in kritischen Jahreszeiten etwas Gutes und füttern Sie sie mit unseren Blütenpollen. Vorallem im Herbst, wenn die Fische einen Energievorrat bilden müssen und im Frühjahr, wenn die Kois aus ihrem Winterschlaf erwachen ist es sinnvoll die Blütenpollen zu füttern.

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39

EFSA Supporting publication 2021:EN-6461

Annex L – Pollen in Trade Agreements

FARIC r	measure information	[Show all information]	The reference date is 06-01-2021 Last TARIC update: 05-01-2021
Goods nomenc	lature code: 1212999510		
Measure type:			
Order number:			
Measure public	ation start date must be after:		
Measure public	ation start date must be before:		
Legal base:			
SECTION II	VEGETABLE PRODUCTS		
CHAPTER 12	OIL SEEDS AND OLEAGINOUS FRU MEDICINAL PLANTS; STRAW AND FO	ITS; MISCELLANEOUS GRAINS, SEEDS A DDDER	ND FRUIT; INDUSTRIAL OR
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	- Seaweeds and other algae :		
	- Other :		
1212 91	Sugar beet :		
1212 92	Locust beans (carob)		
1212 93	Sugar cane		
1212 94	Chicory roots		
1212 99	Other :		
	Locust bean seeds :		
1212 99 95	Other :		
1212 99 95	10 • Bee pollen		
ERGA OM	INES (ERGA OMNES 1011)		
-+l Im	port control of organic products (01-01-20	017 -) (CD808)	<u>R0834/07</u>
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→l Th	ird country duty (01-01-2012 -) : 0 %		R1006/11
Andorra ((AD)		
-+ Tay	riff preference (01-07-1991 -) : 0 %		D0680/90
• 141			
All third o	countries (ALLTC 1008)		
→l ve	terinary control (14-12-2019 -) (CD624) (CD	0686) (CD737)	R2007/19
Exc (LI [Sh	cluding: Andorra (AD) , Switzerland (CH)) , Norway (NO) , San Marino (SM) now conditions]	, Faroe Islands (FO) , Greenland (GL) , Iceland	(IS) , Liechtenstein
CARIFOR	UM (CARI 1033)		
→l _{Tar}	riff preference (29-12-2008 -) : 0 %		D0805/08
Exe	cluding: Haiti (HT)		
Cameroon	n (CM)		
→l _{Tar}	riff preference (04-08-2014 -) : 0 %		D0152/09
Egypt (EG	G)		
→l Tar	riff preference (01-06-2010 -) : 0 %		D0240/10
	nen men kennen er sint fan de kennen in die ster		

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40

EFSA Supporting publication 2021:EN-6461

Western Sahara (EH)	
→ Tariff preference (19-07-2019 -) : 0 % (TM904)	D0217/19
Economic Partnership Agreements (EPA 1032)	
→ Tariff preference (28-07-2016 -) : 0 %	<u>R1076/16</u>
Eastern and Southern Africa States (ESA 1034)	
→ Tariff preference (14-05-2012 -) : 0 %	D0196/12
European Union (EU)	
→ Veterinary control (14-12-2019 -) (CD624) (CD644) (CD686) (CD737) [Show conditions]	R2007/19
Fiji (FJ)	
→ Tariff preference (28-07-2014 -) : 0 %	D0729/09
Faroe Islands (FO)	
→ Veterinary control (14-12-2019 -) (CD624) (CD686) (CD737)	R2007/19
[Show conditions]	
United Kingdom (GB)	
→ Tariff preference (01-01-2021 -) : 0 %	D2253/20
Ghana (GH)	
→ Tariff preference (15-12-2016 -) : 0 %	D1850/16
Greenland (GL)	
→ Veterinary control (14-12-2019 -) (CD624) (CD686) (CD737)	R2007/19
[Show conditions]	
Israel (IL)	
→ Tariff preference (01-01-2010 -) : 0 %	D0855/09
Iceland (IS)	
→ Tariff preference (01-05-2018 -) : 0 %	D1913/17
Jordan (JO)	
→ Tariff preference (01-01-2006 -) : 0 %	D0067/06
North Korea (Democratic People's Republic of Korea) (KP)	
→ Import prohibition (28-02-2018 -) (TM883)	<u>R0285/18</u>
Korea, Republic of (South Korea) (KR)	
→ Tariff preference (01-07-2011 -) : 0 %	D0265/11
Lebanon (LB)	
→ Tariff preference (01-04-2006 -) : 0 %	D0356/06

41

EFSA Supporting publication 2021:EN-6461

OCTs (Overseas Countries and Territories) (LOMB 2080)	
→ Tariff preference (01-01-2014 -) : 0 %	D0755/13
Morocco (MA)	
→ Tariff preference (01-10-2012 -) : 0 %	D0497/12
Moldova, Republic of (MD)	
→ Tariff preference (01-01-2016 -) : 0 %	D0492/14
Mexico (MX)	
→ Tariff preference (01-07-2016 -) : 0 %	D0415/00
Papua New Guinea (PG)	
→ Tariff preference (20-12-2009 -) : 0 %	D0729/09
SADC EPA (SADC EPA 1035)	
→ Tariff preference (10-10-2016 -) : 0 %	D1623/16
Solomon Islands (SB)	
→ Tariff preference (17-05-2020 -) : 0 %	D0729/09
San Marino (SM)	
	D0245/02
Syria (SY)	
→ Tariff preference (01-01-2001 -) : 0 %	R2216/78
Samoa (WS)	
→ Tariff preference (31-12-2018 -) : 0 %	D0729/09

42

EFSA Supporting publication 2021:EN-6461

OCTs (Overseas Countries and Territories) (LOMB 2080)	
→ Tariff preference (01-01-2014 -) : 0 %	D0755/13
Morocco (MA)	
→ Tariff preference (01-10-2012 -) : 0 %	D0497/12
Moldova, Republic of (MD)	
→ Tariff preference (01-01-2016 -) : 0 %	D0492/14
Mexico (MX)	
→ Tariff preference (01-07-2016 -): 0 %	D0415/00
Papua New Guinea (PG)	
→ Tariff preference (20-12-2009 -) : 0 %	D0729/09
SADC EPA (SADC EPA 1035)	
→ Tariff preference (10-10-2016 -) : 0 %	D1623/16
Solomon Islands (SB)	
→ Tariff preference (17-05-2020 -) : 0 %	D0729/09
San Marino (SM)	
→ Customs Union Duty (01-01-2006 -) : 0 %	D0245/02
Syria (SY)	
→ Tariff preference (01-01-2001 -) : 0 %	R2216/78
Samoa (WS)	
→ Tariff preference (31-12-2018 -) : 0 %	D0729/09

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43

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