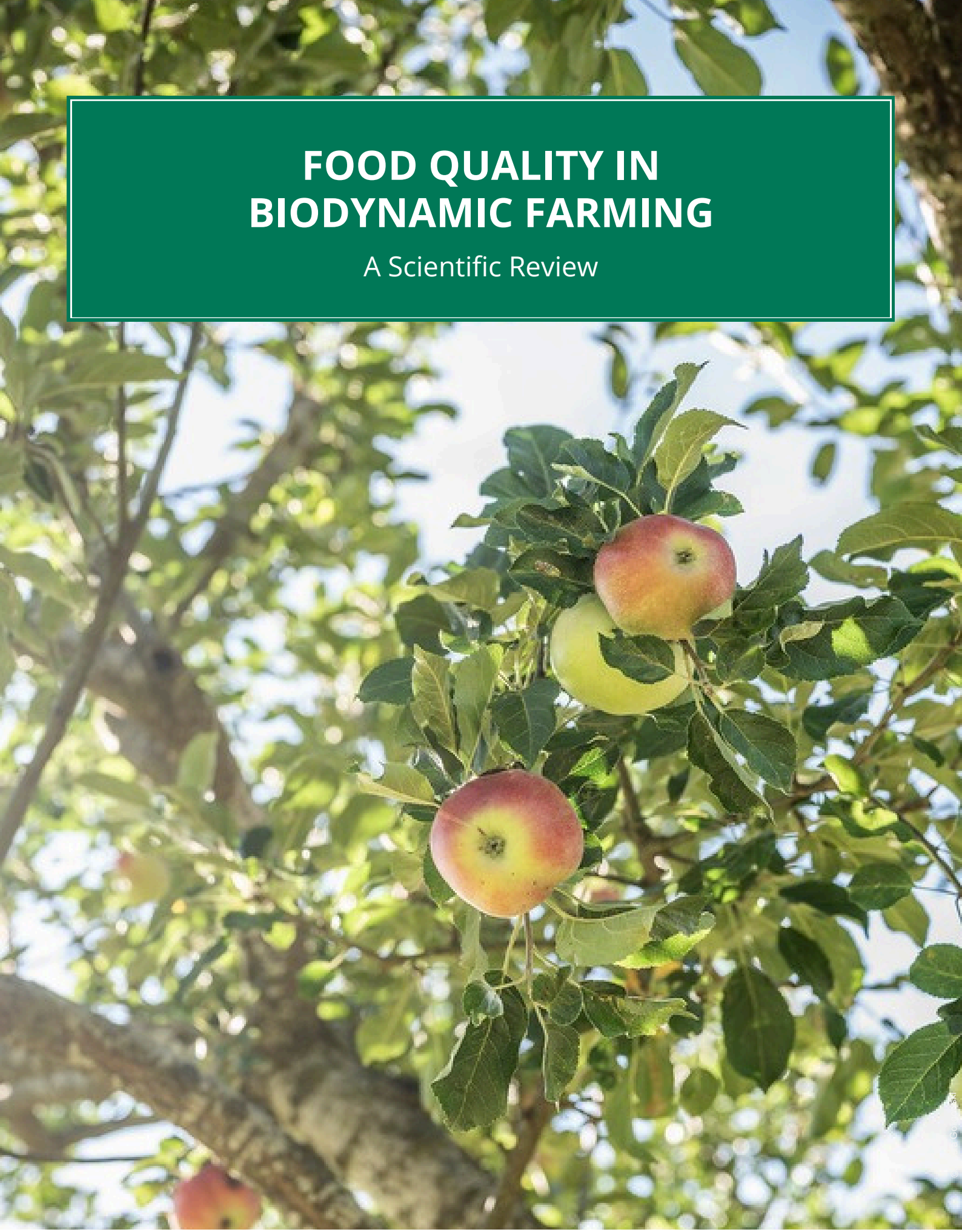
FOOD QUALITY IN BIODYNAMIC FARMING

A Scientific Review



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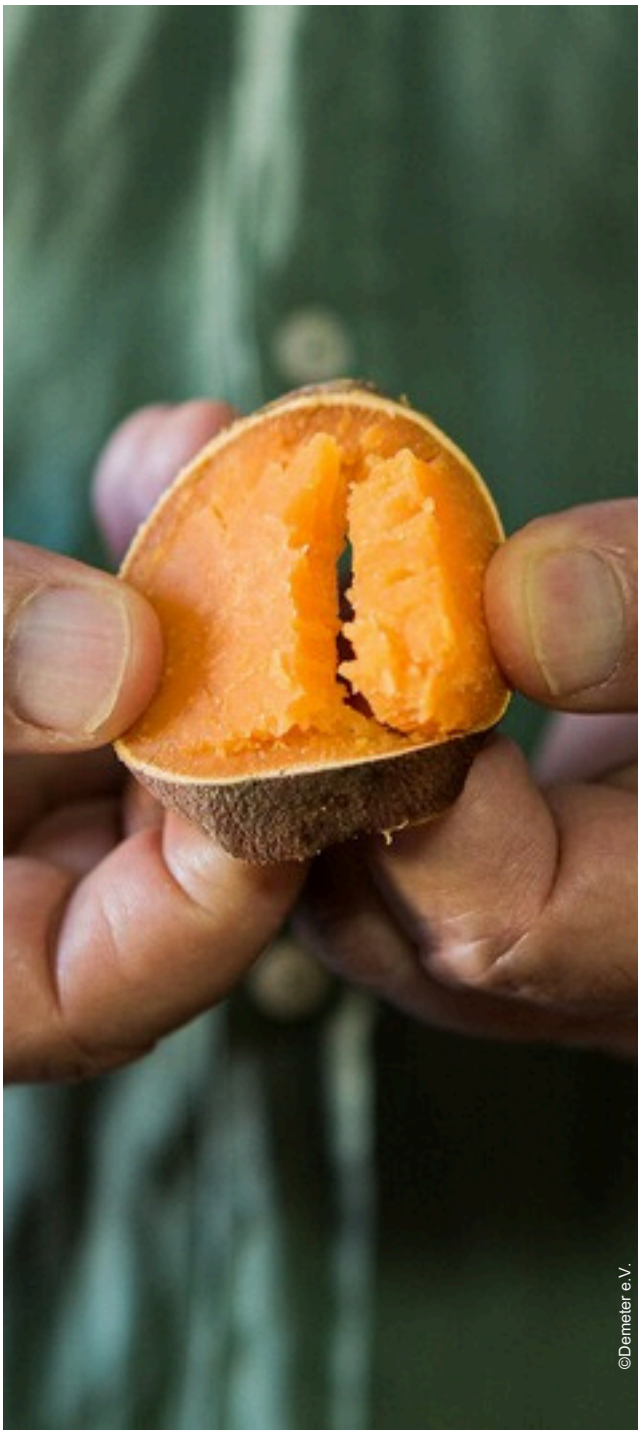
OVERVIEW



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FOOD QUALITY IN BIODYNAMIC FARMING SUMMARY

One of the stated objectives of biodynamic farming is to produce food of high nutritional and taste quality for body and soul. This is one of the reasons why the Demeter label was created well before organic labels.

Although academic research on the food quality of biodynamic products has been conducted for many years, it is only at the beginning of the 21st century that this topic has gained recognition with the publication of scientific articles in peer-reviewed journals.

The number of scientific publications on biodynamic food quality has increased significantly in recent years, together with publications in the fields of viticulture and soil quality. Nutritional properties are the most frequently discussed topic in scientific literature on food quality. In this fact sheet, we provide an overview of current scientific knowledge.

ARE ORGANIC AND BIODYNAMIC FOODS HEALTHIER THAN CONVENTIONAL FOODS?

This is a complex issue on which it is difficult to reach a scientific consensus. With regard to undesirable substances such as pesticide residues, there is no doubt that organic and biodynamic products are healthier than their conventional counterparts.

Based on available data, a trend emerges: organic and biodynamic products tends to contain higher levels of antioxidants, such as polyphenols and flavonoids, than their conventional counterparts, which contributes to their nutritional quality.

However, we still do not have definitive evidence from human food trials regarding the vitality of organic and biodynamic foods, even though the number of publications has increased steadily over the last decades.

FOOD QUALITY IN BIODYNAMIC FARMING SUMMARY

FOOD QUALITY IN BIODYNAMICS, A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

From a scientific point of view, the concepts of quality and vitality are difficult to define and evaluate. Since its inception one century ago, the biodynamic movement has contributed to the advancement of knowledge by developing innovative methods of analysis and evaluation. These include empathic food testing, which focuses on consumer perception, the so-called 'picture forming' methods (e.g. biocrystallisation) or the more recent "cucumber-test" for assessing the vitality of products. The initial results of these methods are promising and make it possible to differentiate between products from organic farming and those from biodynamic farming.

BIODYNAMICS FOR A HOLISTIC APPROACH TO FOOD

According to Santoni et al. (2022), the 'One Health' concept " posits that there is a link between human, animal and environmental health. Indeed, the health conditions of all organisms in an ecosystem are interconnected via the cycles of microbial communities from the environment (particularly the soil) to plants, animals and ultimately humans (Van Bruggen et al., 2019). The 'One Health' approach, combined with the superior performance of biodynamic soils in terms of microbial indicators (Christel et al., 2021), could therefore support the idea that biodynamic products are healthier for consumers.

Find the digital version and more biodynamic facts here:
www.sektion-landwirtschaft.org/en/research/basics

[6] Christel A., Maron P.A., Ranjard L. (2021). *Impact of Farming Systems on Soil Ecological Quality: A Meta-Analysis.* Environmental Chemistry Letters 19, nº 6.

[26] Van Bruggen, A.H.C., Goss, E.M., Havelaar, A., Van Diepeningen, A.D., Finckh, M.R., Morris, J.G. (2019). One Health - Cycling of diverse microbial communities as a connecting force for soil, plant, animal, human and ecosystem health. Science of The Total Environment 664.

[32] Santoni, M., Ferretti, L., Migliorini, P., Vazzana C. & Pacini G. C. (2022) A review of scientific research on biodynamic agriculture. Org. Agr. 12, 373–396.

CONTEXT AND CHALLENGES

HISTORY OF THE DEMETER LABEL

Biodynamic agriculture is based on two observations made by farmers a good hundred years ago: a decline in vital forces was reflected in the fertility of farm animals as well as in the nutritiousness of agricultural products. Instead of just proposing individual measures, Rudolf Steiner, who was in demand by farmers, inspired a new, holistic agricultural system in 1924 with eight lectures. The Experimental Circle (Versuchsring), which was founded at the same time, worked this out in practice and established both the farming method - biodynamic (1927) - and the Demeter brand (1928). The initial focus was on a way of agriculture to improve food quality based on the conscious and targeted management of natural processes, cycles and rhythms.

Consequently, the first "standard regulation" of Demeter quality in guidelines in 1928 defined requirements for the production of food: soil and management had to be biodynamic, as well as the seeds, and the biodynamic feed was decisive for the milk. The quality of the food thus was guaranteed by biodynamic cultivation from the start.

In 1994, Demeter Germany was the first organic association to publish guidelines for processing, which, among other things, laid down the practice, e.g. of selling Demeter milk only in bottles and non-homogenized, and were based on processes that conserve the raw material and emphasize artisanal quality.

But how do Demeter foods differ from others? The vast majority of older studies compare biodynamic with conventional foods – due to a lack of alternatives. With the establishment of organic farming, however, a direct comparison with organic products is needed. This is the case, for example, in the so-called D-O-K trial of FiBL (Knapp et al., 2023) or in the Geisenheim INBIODYN trial on wine (Meissner et al., 2019), or in the six-year apple cultivation trial in Weinsberg (Balzer-Graf et al., 1998).

So far, mainly raw products have been tested – but it would also be interesting to include processing: Demeter dispenses with problematic techniques such as ultra-high temperature (milk) or cross-flow filters (wine), as well as technical enzymes and other questionable additives or additives.

The fact that Demeter's quality standards also extend to distribution channels is shown by the requirements of the Demeter sales principles adopted in 2016.

[4] Balzer-Graf, U., Hoppe, H., Straub, M. (1998). *Äpfel – organisch und biologisch-dynamisch.* Erntemenge und Vitalqualität im Vergleich. Lebendige Erde 5/1998, page 387.

[18] Knapp, S., Gunst, L., Mäder, P., Ghiasi, S., Mayer, J., (2023). Organic cropping systems maintain yields but have lower yield levels and yield stability than conventional systems – Results from the DOK trial in Switzerland. Field Crops Research 302.

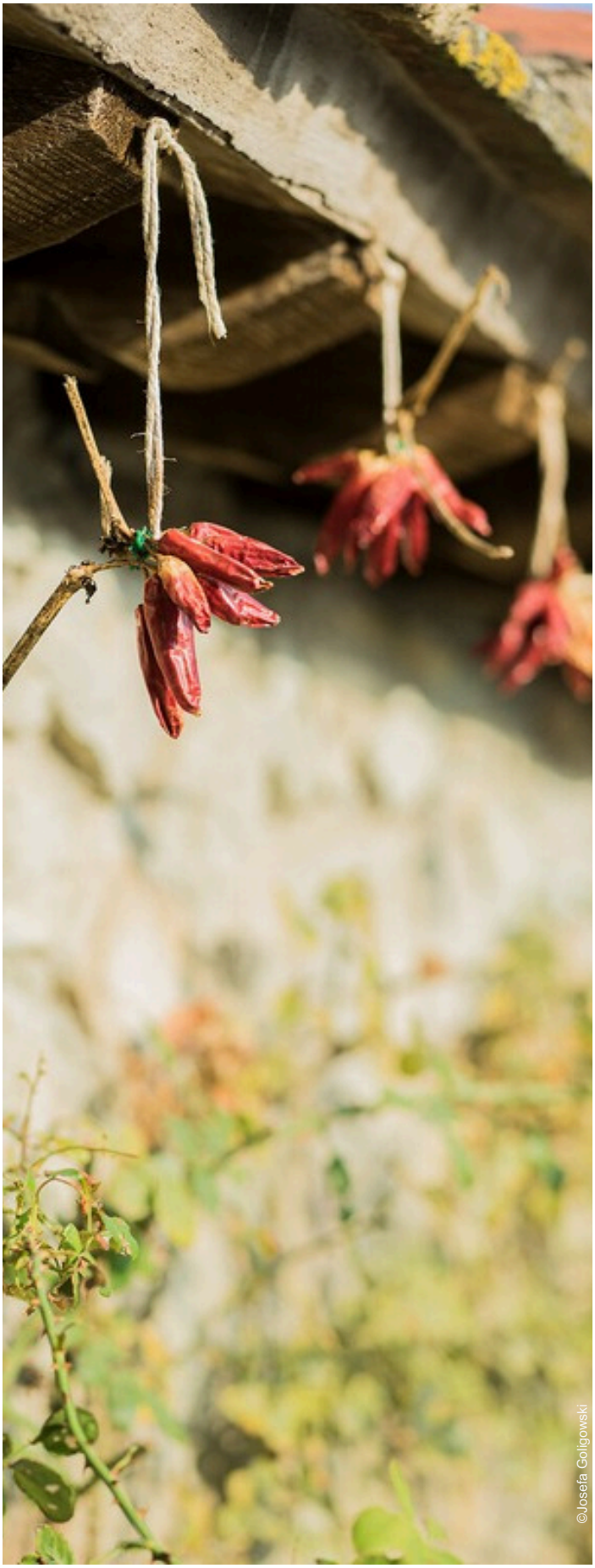
[20] Meissner, G., Athmann, M.E., Fritz, J., Kauer, R., Stoll, M., Schultz, H.R. (2019). Conversion to Organic and Biodynamic Viticultural Practices: Impact on Soil, Grapevine Development and Grape Quality. OENO One 53, nº 4.

CONTEXT AND CHALLENGES

REGULATORY FRAMEWORK AND LEGAL DEVELOPMENTS CONCERNING THE QUALITY OF BIODYNAMIC FOOD

The rules of biodynamic agriculture with regard to cultivation and processing are more restrictive than those applicable to organic agriculture. Biodynamic food comes from farms whose land has completed its conversion period. Demeter expects animals on each farm, but in cases where that isn't feasible, a formal fodder-manure cooperation with another (preferably biodynamic) farm can fulfill the minimum animal-husbandry requirement. Animals should be fed with biodynamic feed for at least 70% of the feed ration for ruminants and at least 60% of that for all other animals. At least 60% of the fodder for ruminants (and 50% for pigs and poultry) comes from the farm itself, which supports the ideal of an autonomous agricultural organism. Demeter farmers should use biodynamic seeds when available and genetically modified seeds and varieties are excluded categorically.

When it comes to processing, methods that best preserve the quality of the food must be used: milk cannot be homogenized, and sterilisation (UHT) is prohibited. Only a limited number of additives are permitted in processing. Iodisation, the use of nitrates and "natural" flavourings are prohibited. Only natural flavour extracts, e.g. from fruits, are permitted. The EU organic standard still allows additives that are prohibited by Demeter biodynamic standards. Processors may only use 14 certified additives, compared to around 50 in organic processing and around 400 in the conventional industry.



ARE ORGANIC AND BIODYNAMIC FOODS HEALTHIER THAN CONVENTIONAL FOODS?

PESTICIDE RESIDUES IN ORGANIC AND BIODYNAMIC FOODS

The presence of toxic agrochemicals in the soil can have negative effects on crop yields and human health. In the work of Aina et al. (2008), white clover was used as a bioindicator to assess the impact of three different agricultural practices (including biodynamic management) on soil genotoxicity in Italy. The results showed that all three soils caused damage to the DNA of the indicator plants. Nevertheless, based on the present results, the biodynamic farming system appears to be the best agricultural approach for maintaining soil quality in terms of genotoxicity.

To assess the nutritional value of the food we consume, we cannot consider only the agricultural raw materials. We must also take into account processing. The fact is that products that appear 'natural' at first glance may in fact be highly processed.

The processing of many foods involves the addition of a wide range of substances and chemicals, most of which are indicated by numbers beginning with the letter 'E'. Many products contain flavourings that do not need to be declared as long as the quantity is below a certain threshold.

Residues of undesirable substances are less significant in organic and biodynamic products. This applies in particular to contaminants such as pesticides and cadmium (Lister et al. 2024 ; Jiang et al. 2024).

[1] Aina, R., Berra, E., Marino, G., Sgorbati, S., Citterio, S. (2008). *Impact of different agricultural practices on soil genotoxicity*. Fresenius environmental bulletin, Volume 17, Page 1190-1194.

[17] Jiang, B., Pang, J., Li, J., Mi, L., Ru, D., Feng, J., Li, X., Zhao, A., Cai, L. (2024). The effects of organic food on human health: a systematic review and meta-analysis of population-based studies. Nutr Rev;82(9):1151-1175.

[19] Lister, C., Wallace, A., Trolove, S., Anderson, C., Harker, R. (2024). Nutritional density of foods produced from biodynamic, organic, and conventional land use systems – Phase 1. A Plant & Food Research report prepared for: Kete Ora Charitable Trust. Milestone No. 99503.

ARE ORGANIC AND BIODYNAMIC FOODS HEALTHIER THAN CONVENTIONAL FOODS?

THE EFFECTS OF FARMING METHODS ON FOOD QUALITY

It is clear that the cultivation method not only affects the soil, humus content, and soil organisms, including the soil microbiome, but also influences crops. Fertilization with readily soluble nitrogen generally results in higher yields than in organic and biodynamic crops. This has been demonstrated in a 45-year comparative study of conventional, organic, and biodynamic farming systems for potatoes, wheat, corn, and clover, with the sole exception of soybeans, which, as legumes, have nitrogen-fixing properties (Fliessbach et al., 2024).

Soil conditions influence the interaction between plant growth and differentiation/ripening processes. In organic and biodynamic products, this balance is often better than in conventional products, where there is a shift towards the growth process and a lack of ripening properties. This is reflected in the content of secondary plant compounds such as phenolics (e.g. flavonoids) and antioxidant activity that are often higher in organic and biodynamic products than their conventional counterparts (Lister et al., 2024). In a review by Brock et al. (2019), 17 out of 21 studies showed a higher content of secondary compounds in biodynamic products compared to organic or conventional. Similarly, in a test of more than 800 cucumbers purchased on the market, conventional samples had a significantly lower dry matter content than organic and biodynamic samples (Doesburg-van Kleffens, 2025).

Polyphenols and Flavonoids: Importance for Food Quality

Polyphenols are natural plant compounds with antioxidant properties. They help:

- Prevent oxidation of fats, vitamins, and other nutrients, extending shelf life.
- Enhance color, flavor, and aroma of foods (e.g., tannins in wine).
- Protect against enzymatic and microbial spoilage, contributing to overall food stability.

Flavonoids are a subclass of polyphenols, often responsible for the bright colors in fruits and vegetables. They:

- Act as strong antioxidants, improving nutritional value and food preservation.
- Influence appearance (color) and taste (bitterness or astringency).
- Provide added health benefits when consumed.

[5] Brock, C., Geier, U., Greiner, R., Olbrich-Majer, M., Jürgen Fritz, J. (2019). *Research in Biodynamic Food and Farming – a Review.* Open Agriculture 4, nº 1.

[8] Doesburg-van Kleffens M., Andersen J.O., Gründemann C., Fritz J. (2025). Effects of cultivation systems on the antimicrobial, colour retainment and slice healing properties of consumer ready market samples of cucumber (Cucumis sativus L.). Applied Food Research 5, nº 1.

[9] Fliessbach A., Krause H.M., Jarosch J.M., Mayer J., A. Oberson A., Mäder P. (2024). A 45-year comparative study of organic and conventional cropping systems. Factsheet from the FIBL, 52 pages.

[19] Lister, C., Wallace, A., Trolove, S., Anderson, C., Harker, R. (2024). Nutritional density of foods produced from biodynamic, organic, and conventional land use systems – Phase 1. A Plant & Food Research report prepared for: Kete Ora Charitable Trust. Milestone No. 99503.

FOOD QUALITY IN BIODYNAMICS: A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

Innovative methods of quality analysis were developed very early on, starting with copper chloride biocrystallization based on Kolisko and Pfeiffer's work in 1930. However, it was only after extensive methodological research that this method was scientifically recognized in the 2010s (Huber et al., 2010). In addition to biocrystallization, other picture-forming methods have been developed by biodynamic researchers, such as capillary dynamolysis (Steigbild) and circular chromatography, as well as various tests to assess the vitality of plants and foods. At the same time, methods focused on human perception of quality have also been used. Two of them, sensory analysis and empathic food testing, are recognized as scientific methods (ISO 6658:2017 ; Geier et al., 2016).

BIOCRYSTALLIZATION

Biocrystallization has become the most commonly used and scientifically advanced imaging method. The method is based on the emergence of specific crystallization patterns on a glass plate when a copper chloride solution is mixed with a food extract and then crystallized. The tested extract affects the shape of the pattern arising during the self-organizing crystallization process. Recent studies have standardized practices for implementing sensitive crystallization, including all laboratory procedures, crystallization chamber properties, and scientific validation steps (Huber et al., 2010).

In practice, image analysis has been used successfully to distinguish samples from biodynamic, organic, and conventional production methods. Beyond simple discrimination, pattern formation in picture-forming methods can be linked to plant growth conditions. Physiological processes, such as decomposition and ripening, are reflected by crystallization and chromatography patterns in a reproducible and characteristic manner.

These patterns can therefore be used as a reference when studying the quality of food products. Extensive experimental data on a wide variety of agricultural products have shown that the crystallization patterns of foods produced with low nitrogen fertilization, or from biodynamic or organic samples, reveal image qualities that indicate greater maturity or vitality than samples produced with high nitrogen fertilization or from conventional production. Thus, these specific evaluation methods express overall aspects of food quality by analyzing the characteristics of the food product as a whole, rather than simply the concentrations of isolated chemical compounds (Fritz et al., 2020).

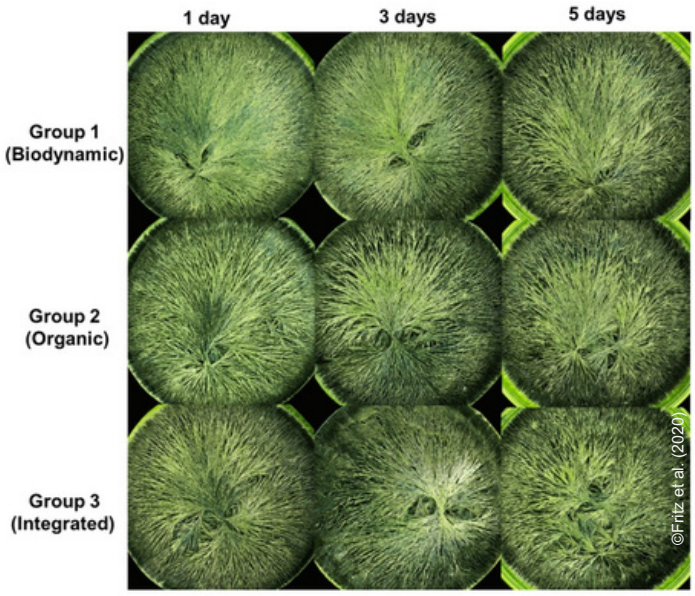


Figure 1: Juice deterioration of INT, ORG and BIODYN farming systems. From left to right: i) samples needed more juice per sample for similar form expression, and ii) samples showed more pronounced structural features that indicate enhanced aging/deterioration (Fritz et al., 2020).

[10] Fritz, J., Athmann, M., Meissner, G., Kauer, R., Geier, U., Bornhütter, R., & Schultz, H. (2020). *Quality assessment of grape juice from integrated, organic and biodynamic viticulture using image forming methods.* OENO One, 54(2).

[12] Geier U., Buessing A., Kruse P., Greiner R., Buchecker K. (2016). *Development and Application of a Test for Food-Induced Emotions.* PLoS ONE 11(11).

[14] Huber, M., Andersen, J. O., Kahl, J., Busscher, N., Doesburg, P., Mergardt, G., … Baars, E. (2010). *Standardization and Validation of the Visual Evaluation of Biocrystallizations.* Biological Agriculture & Horticulture, 27(1), 25–40.

[16] ISO 6658: (2017). Sensory analysis — Methodology — General guidance. www.iso.org/standard/65519.html

FOOD QUALITY IN BIODYNAMICS: A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

CAPILLARY DYNAMOLYSIS AND CIRCULAR CHROMATOGRAPHY

Two other picture-forming methods are frequently associated with biocrystallization: capillary dynamolysis (or Steigbild) and Pfeiffer round chromatography.

These are two imaging methods in which a sample to be tested (e.g., grape juice), combined with a chemical agent (silver nitrate), migrates on vertical or horizontal filter paper to generate a series of forms that can then be analyzed based on rigorous criteria. These two methods are often associated with biocrystallization in food quality studies, and tests already conducted make it possible to accurately identify and classify samples according to biodynamic, organic, or conventional production methods. Such tests have been carried out with samples of wheat, carrots, apples, and grapes (see Zalecka et al., 2010; Fritz et al., 2011 and 2020).

While imaging-based quality assessment tools show promise based on the initial results obtained by th

community of researchers involved in their development, they still need to be refined in order to better understand the links between the differences observed in the images and the characteristics of the food products.

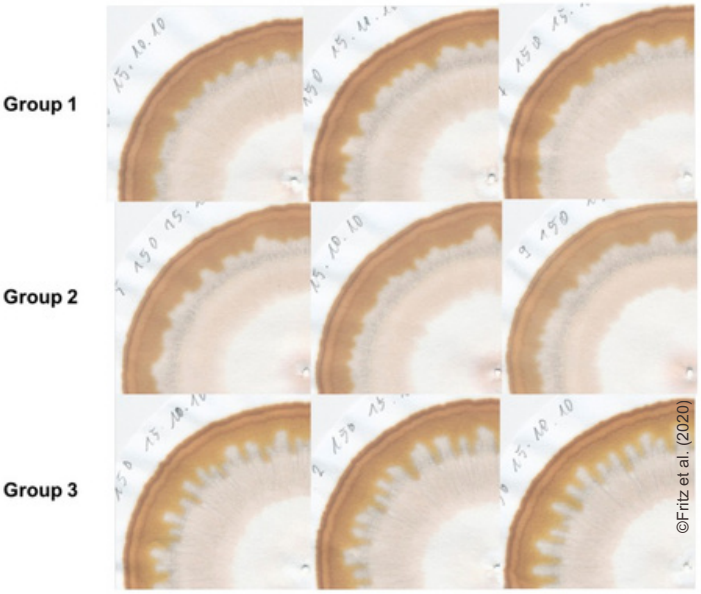


Figure 2: Discrimination of 9 samples in 3 groups (n=3) from BIODYN (group 1), ORG (group 2) and INT (group 3) farming systems. Circular chromatography images of grape juice pressed with the standard procedure at Geisenheim harvest year 2010 (juice aged 2 days at 5 °C; all images 0.150 ml juice) (Fritz et al., 2020).

[10] Fritz, J., Athmann, M., Meissner, G., Kauer, R., Geier, U., Bornhütter, R., & Schultz, H. (2020). Quality assessment of grape juice from integrated, organic and biodynamic viticulture using image forming methods. OENO One, 54(2).

[11] Fritz, J., Athmann, M., Kautz, T., & Köpke, U. (2011). Grouping and classification of wheat from organic and conventional production systems by combining three image forming methods. Biological Agriculture & Horticulture, 27(3–4), 320–336.

[30] Zalecka, A., Kahl, J., Doesburg, P., Pyskow, B., Huber, M., Skjerbaek, K., & Ploeger, A. (2010). Standardization of the Steigbild Method. Biological Agriculture & Horticulture, 27(1), 41–57.

FOOD QUALITY IN BIODYNAMICS: A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

SENSORY EVALUATION

Sensory evaluation remains a recognized method of quality assessment, particularly in oenology. The available studies on wines present contrasting results: Ross et al. (2009) were able to differentiate between organic and biodynamic wines through sensory evaluation. Meissner was able to partially differentiate them on a sensory level (Brock et al., 2019), while Parpinello et al. (2015) found no sensory difference between organic and biodynamic wines.

In a study published in 2021, Delmas & Gergaud analyzed the evaluations of 128,182 wines rated by French tasting experts, allowing them to compare the ratings of eco-labeled wines with or without certification to conventional wines. The results show that biodynamic wines are rated higher than organic wines (by an average of 5.6 points) and that organic wines also stand out from conventional wines (by an average of 6.2 points).

Pineau & Foyer (2024) conducted a sociological study of how biodynamic wine gives rise to new forms of tasting that go beyond organoleptic criteria alone to encompass the receptivity of the entire body involved in the act of drinking. Biodynamic wines are recognized by connoisseurs for their lively, vibrant, and energetic qualities.

[5] Brock, C., Geier, U., Greiner, R., Olbrich-Majer, M., Jürgen Fritz, J. (2019). *Research in Biodynamic Food and Farming – a Review.* Open Agriculture 4, nº 1.

[7] Delmas, M. A. & Gergaud, O. (2021). Sustainable practices and product quality: Is there value in eco-label certification? The case of wine. Ecological Economics, Volume 183, 2021, 106953. ISSN 0921-8009.

[21] Parpinello, G.P., Rombolà, A.D., Simoni, M., Versari, A. (2015). *Chemical and sensory characterisation of Sangiovese red wines: Comparison between biodynamic and organic management.* Food Chemistry 167.

[22] Pineau, C. & Foyer, J. (2024). Tasting life and energy with the body: the biodynamic resonance of wine. The Senses and Society. 19(2), 157–171.

[24] Ross, C.F., Weller, Blue K.M., Robert, B., John, P. Reganold. (2009). Difference Testing of Merlot Produced from Biodynamically and Organically Grown Wine Grapes. Journal of Wine Research 20, nº 2.

FOOD QUALITY IN BIODYNAMICS: A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

EMPATHETIC FOOD TESTING

The organoleptic qualities of wheat flours from the FiBL DOC trial, which has been comparing conventional, organic, and biodynamic production methods since 1978, have also been the subject of sensory analysis. In this respect, biodynamically grown wheat differs more clearly from conventional wheat than organic wheat (Arncken et al., 2012).

Everyone knows the impact of food that lasts longer than its taste. You may know the calming effect of cream, or how coffee makes you feel more awake. On closer observation, it turns out that staple foods and beverages also affect our physical and mental state. The emotional and bodily sensations induced by food can be described as the impact behind the taste. Empathic Food Testing describes the measurement of emotional and bodily sensations induced by food. These impacts differ from short sensory impressions and personal preferences. This type of conscious tasting is also beneficial for people because it promotes consumer competence and awareness in nutrition. Empathic food testing has been developed very recently using a scientific methodology (Geier et al., 2016). As the method is still very young, there are only a few studies published in the scientific literature until now (Wohlers et al., 2024; Geier et al., 2025), but the interest in the method is growing.

[2] Arncken, Christine M.; Mäder, Paul; Mayer, Jochen and Weibel, Franco P. (2012) *Sensory, yield and quality differences between organically and conventionally grown winter wheat,* Journal of the Science of Food and Agriculture (J Sci Food Agric).

[12] Geier U., Buessing A., Kruse P., Greiner R., Buchecker K. (2016). Development and Application of a Test for Food-Induced Emotions. PLoS ONE 11(11).

[13] Geier U, Mandt G., Keller J., Helmert E, Vagedes J. (2025). Heart Rate Variability Measurement and Emotional Profiling to Describe Milk Quality? Milk Science International (78) 19-26.

[29] Wohlers, J., Stolz, P., & Geier, U. (2024). Intensive processing reduces quality of grains: a triangulation of three assessment methods. Biological Agriculture & Horticulture, 40(2), 107–126.

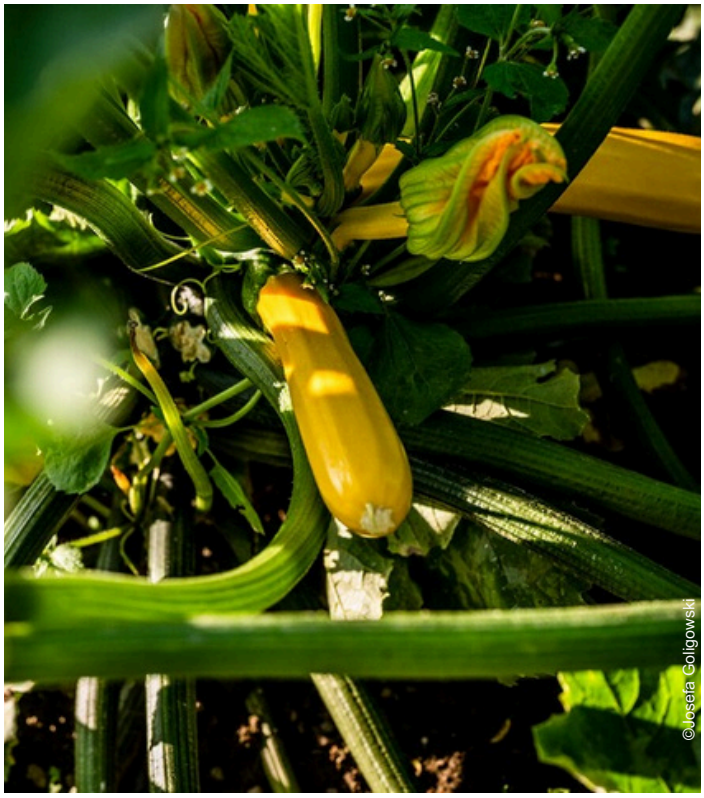
FOOD QUALITY IN BIODYNAMICS: A FIELD OF INNOVATION FOR NEW SCIENTIFIC METHODS

VITALITY TEST

The vitality of a food can be characterized by its ability to resist degradation processes caused by aging or external stress. Jens-Otto Andersen and his team have therefore designed a vitality test based on the evaluation of three parameters of the cucumber: antimicrobial properties, color retention, and the healing capacity of sliced fruits. As with the picture-forming methods mentioned above, this method has undergone a standardization process to ensure its reproducibility in a scientific context (Rembiałkowska et al., 2021).

The results show that biodynamic cucumbers have the highest values for all three stress parameters. In addition, it was found that cucumbers from biodynamic systems had the best shelf life under stress conditions in 58 to 71% of tests, compared to only 25 to 38% of tests for cucumbers from organic farming and 4 to 8% of tests for cucumbers from conventional farming (Doesburg-van Kleffens et al., 2025).

Figure 3: Ring trial 4. Cucumbers after 14 days of stress induced storage from organic with low fertilisation (OrgN-, left side) and conventional (Conv, right side). Colour Retainment Properties (CRP) as mean value of 12 cucumbers for each cultivation method: OrgN-: 3.58 and Conv: 2.50 ($p = 0.009$); Antimicrobial Properties (AMP) as mean value of 12 cucumbers for each cultivation method: OrgN-: 8.00 and Conv: 1.58 ($p < 0.001$). (Zeise et al., 2023).



DELAYED LUMINESCENCE

It has been known since the 1930s that living organisms emit light in the form of biophotons of different wavelengths (or colors) between ultraviolet and infrared in the electromagnetic spectrum. The unique feature of this method is that it is not necessary to first transform a given sample into juice or in any other way. During the examination, the sample is first illuminated with colored light, and then the “delayed luminescence,” i.e., biophotonic radiation, is measured. This delayed luminescence, studied by Stolz et al. (2019) on samples of plant origin (wheat, apples, carrots, beans, calendula) and animal origin (eggs, milk), seems to reveal something about the physiological processes of the sample. Growing conditions, the freshness or integrity of a sample, or factors related to animal welfare or health have repeatedly shown important in explaining the luminescence profiles observed. A promising method for assessing food quality?

[8] Doesburg-van Kleffens M., Andersen J.O., Gründemann C., Fritz J. (2025). *Effects of cultivation systems on the antimicrobial, colour retainment and slice healing properties of consumer ready market samples of cucumber (Cucumis sativus L.).* Applied Food Research 5, n° 1.

[23] Rembiałkowska, E., Kazimierczak, R., Zupancic, M., Skerbot, I., Mc Nair, P., & Andersen, J. O. (2021). A novel method for assessing antimicrobial, colour retainment and slice healing properties of the fruit of cucumber (Cucumis sativus L.) as complementary quality parameters. Biological Agriculture & Horticulture, 37(4), 213–233.

[25] Stolz, P., Wohlers, J. and Mende, G. (2019). Measuring delayed luminescence by FES to evaluate special quality aspects of food samples – an overview. Open Agriculture, Vol. 4 (Issue 1), pp. 410-417.

FOR A HOLISTIC APPROACH TO FOOD

THE HEALTH OF SOIL, PLANT, ANIMAL AND MAN IS ONE AND INDIVISIBLE

According to Santoni et al. (2022), the “One Health” concept posits that there is a link between human, animal, and environmental health. Indeed, the health conditions of all organisms in an ecosystem are interconnected through the cycles of microbial communities from the environment (particularly the soil) to plants, animals, and ultimately humans (Van Bruggen et al., 2019). The “One Health” approach, combined with the superior performance of biodynamic soils in terms of microbial indicators (Christel et al. 2021), could therefore support the idea that biodynamic products are healthier for consumers.

Sir Albert Howard, one of the fathers of organic farming, observed as early as 1948 that “The health of soil, plant, animal and man is one and indivisible.” A few years before his death, he published the book An Agricultural Testament, in which he summarized his observations and experiences. His insights are now confirmed by recent discoveries about microbiomes.

The relationship between gut bacteria and human health is well known. However, how bacterial communities differ in different parts of apples and whether they are influenced by the method of cultivation is less well studied. This is important not only for the plants themselves, but also for microbial colonization in humans. Wassermann et al. (2019) compared the microbiome of apples from biodynamic and conventional agriculture. They showed that, although the number of bacteria was not influenced by the cultivation method, the diversity and uniformity of the distribution of bacteria were significantly higher in apples from biodynamic agriculture, which also contained fewer pathogens. The difference was even more pronounced when comparing different tissues of apples from the two cultivation methods. With the exception of the calyx tip, all parts (stem, stem tip, skin, fruit pulp, seeds) showed significantly higher diversity in biodynamic apples.

[6] Christel A., Maron P.A., Ranjard L. (2021). *Impact of Farming Systems on Soil Ecological Quality: A Meta-Analysis.* Environmental Chemistry Letters 19, nº 6.

Santoni et al. (2022)

[26] Van Bruggen, A.H.C., Goss, E.M., Havelaar, A., Van Diepeningen, A.D., Finckh, M.R., Morris, J.G. (2019). One Health - Cycling of diverse microbial communities as a connecting force for soil, plant, animal, human and ecosystem health. Science of The Total Environment 664.

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FOR A HOLISTIC APPROACH TO FOOD

Bacteria play an essential role in human and plant health. The microbial diversity of vegetables, fruits, and herbs and their interaction with the environment are still poorly understood. For example, diversity is determined by the plant's genotype, varies between underground and above-ground structures, and is strongly influenced by soil quality, among other factors. Apples are one of the most widely consumed fruits in the world. Studies show that eating apples can alter the composition of the gut bacterial flora in humans, which has beneficial effects on health. However, little is known about how the bacterial communities present in apples colonize the gut. One of the research questions in the study by Wassermann et al. (2019) was to what extent the apple microbiome is influenced by the method of cultivation, biodynamic or conventional, and whether the quantity and composition of bacteria differ depending on the fruit tissue.

A freshly harvested apple harbors around 100 million bacterial gene copies. However, it is not so much the quantity as the diversity of microorganisms that is decisive for the health effect. If plants grow in healthy soil that is cultivated without chemical fertilizers, a rich diversity of bacteria can develop not only in the soil but also in the plants. This is shown by the results of this study. Further studies have shown that the bacteria associated with fruit and vegetables can be detected in the human gut (Wicaksono et al., 2023). If the diversity is high, pathogenic bacteria are suppressed. The researchers also suspect a connection between the bacteria found in Demeter apples and a lower risk of allergy to apples. The bacteria have structures that, similar to apple polyphenols, can minimize allergic reactions. In contrast, the conventional apples had potential pathogens. These correlations emphasize how important the soil-plant-intestinal microbiome axis is (Wassermann et al. 2019). If we consider this further, it becomes clear from the context that health can only be achieved if all parts, from the soil to the plate, are healthy; it is therefore about the one single health for people and planet.

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HEALTH AND INNER NOURISHMENT

In his 1987 book, “Unraveling the Mystery of Health: How People Manage Stress and Stay Well”, Aaron Antonovsky develops the concept of salutogenesis, which consists of understanding how individuals develop and maintain a harmonious state of health on a daily basis. Health is no longer simply the absence of disease, and Antonovsky emphasizes the “sense of coherence” in life, which allows individuals to be rooted in a meaningful life context. He thus highlights the relationship between body and mind: health is strongly influenced by our emotions and mental state.

This approach is confirmed by Machteld Huber (2011), who proposes an understanding of health that involves maintaining the body and mind in a dynamic balance in the face of the tensions and stress inherent in life.

This researcher points out that the WHO's definition of health was developed at a time when infectious diseases were the main challenge for national health systems. However, we are now facing an explosion of different lifestyle-related diseases. The ability of individuals to manage their personal circumstances and health is now much more relevant and necessary for developing a definition.

Thus, a healthy future can be achieved if food systems—i.e., production, processing, trade, and consumption—are transformed. It is not enough to eat healthy and nutritious food; conditions and attitudes must also be healthy too. Because the top environmental problems are selfishness, greed and apathy, like Gustave Speth, former Chair of the UN Development Programme, stated.

This requires a spiritual and cultural transformation, a true inner revolution.

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PARTNERS

The Biodynamic Federation Demeter International is the only agricultural association that has built up a network of individual certification bodies for biodynamic farmers worldwide. Today, they are a global community of farmers, winemakers, gardeners, beekeepers, researchers, advisors, trainers, certifiers, processors and traders to name a few. Find more information at: www.demeter.net

The aim of the Biodynamie Recherche association is to promote respect for and protection of the environment through biodynamic agriculture. It carries out scientific monitoring of work and publications in biodynamic agriculture at international level. It produces summaries, translations and articles which are made available to the Frenchspeaking public on its website and in specialist journals. Find more information at: www.biodynamie-recherche.org

Demeter is a private certification body for biodynamically produced food, cosmetics and textiles - complementary to the official organic regulations. Their specifications have been developed over the decades to become one of the most demanding. Find more information at: www.demeter.de

The Forschungring was founded in 1946 as the successor to the Versuchsrings of Anthroposophical Farmers. In the early years it was the umbrella organisation of the biodynamic movement. Today it is the central research institute for biodynamic and general ecological questions at the centre of a worldwide and growing biodynamic movement. Find more information at: www.forschungsring.de

Through its contacts with people active in the biodynamic movement around the world, the agriculture section encounters many questions, ideas and challenges. Together with their partners, they work on these themes in various international projects and events. In this way, they create spaces in which questions and challenges can be transformed into sources of inspiration for those active in biodynamic agriculture and the food sector. Find more information at: www.sektion-landwirtschaft.org