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CHICORY FOR PROCESSING – A CROP FOR THE FUTURE

ABSTRACT

The paper presents the results of many studies that highlight the importance of this plant for health and nutrition. According to the research studies, chicory is an alternative to coffee, for the development of new ingredients for food and beverages, food supplements, fodder and feed for animals. An analysis of the evolution of areas and yields in chicory destined to processing in Europe reveals an increasing interest only for a limited number of producers. Although this crop is not grown in Romania, chicory production represents an opportunity for producers in our country, being a plant specific to the temperate climate. It also represents an opportunity for the development of new businesses in its processing. In the future, organic chicory production will respond to the requirements of the Farm to Fork Strategy, but also of consumers, fact confirmed by the increasing organic imports in the EU.

Key words: chicory, health, yields, market.

JEL Classification: Q11, Q12.

1. INTRODUCTION

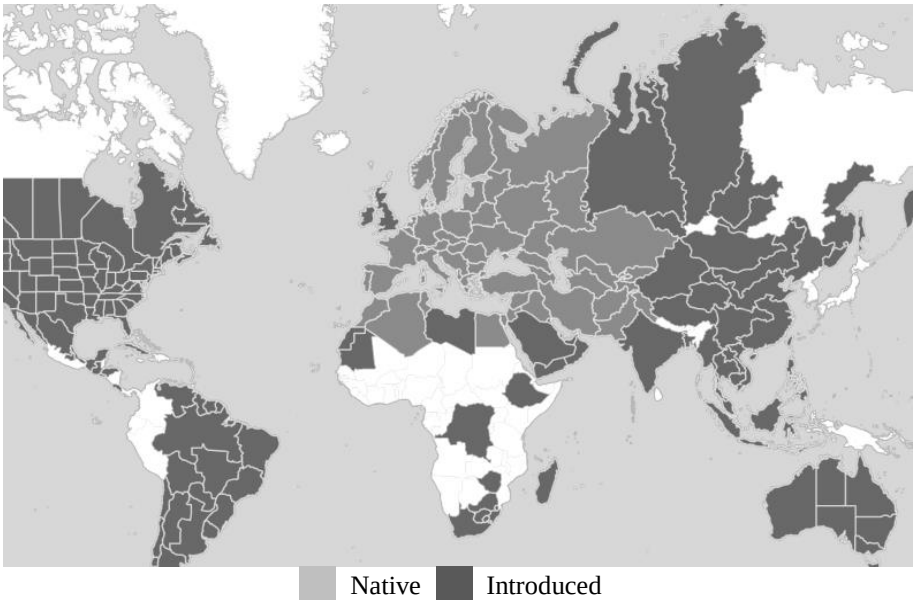
People are now eating more foodstuffs high in energy, fat, free sugars and salt/sodium and less dietary fibres. Food choices and food behaviour are increasingly discussed in health terms. There are public concerns about increasing incidence of lifestyle-related non-communicable diseases, which could be partially prevented by improving eating behaviours. In promoting healthy eating, food producers have a role to play in providing better options for consumers when shopping for food.

2. STATE OF KNOWLEDGE

According to the Integrated Taxonomic Information System, the common chicory (Cichorium intybus L.) is a herbaceous, perennial, edible plant. The native area of this species is from Europe to Central Asia and the W. Himalayas,

Macaronesia (Western coasts of Europe and Africa) up to N. Africa. It is a perennial plant and grows mainly in the temperate biome. It is part of the spontaneous flora of Romania.

Chicory root was widely used as a coffee substitute during the Great Depression and the World War 2, when coffee was in short supply or too expensive. Chicory roots are harvested in less than 20 countries worldwide. At present, there is a return to chicory consumption due to its health benefits. Chicory root is the main extraction source for the commercial production of inulin. Inulin is a food supplement under powder form, 100% natural, recommended as a bowel support prebiotic.



Source: https://powo.science.kew.org/

Figure 1: Cichorium intybus L. growing area

3. MATERIAL AND METHOD

The existing literature on the impact of chicory and chicory extract consumption on human and animal health and production increases was analysed. Market reports and market prospects were studied, including the major players operating in the market. European statistical data were analysed regarding the evolution of the area and production of chicory intended for processing. Imports of organic products were studied as an important aspect in reaching the objectives of the EU Farm to Fork Strategy.

4. RESULTS AND DISCUSSIONS

Importance for health. In the tradition of many peoples, chicory is used for treating various health disorders.

Table l

Traditional medicinal uses of *Cichorium intybus*

Country	Traditional use	Plant parts	Preparations
Afghanistan	Malaria	Root	Aqueous extract
Bosnia and Herzegovina	Diarrhea, strengthening the prostate and other reproduction organs, lung cancer, hangover and purification of the biliary tract	Aerial part, flowers, roots	Did not declare
	Liver disorders, spasmolytics, cholesterol, antiseptics	Airy	Decoction
Bulgaria	Cholagogue stimulant of gastric secretion, hypoglicemiant effect	Roots, aerial parts	Decoction
India	Liver disorders	Seeds	
	Diabetes	Whole plant	Did not declare
	Jaundice, liver enlargement, gout and rheumatism	Root	Decoction
	Cough relief	Did not declare	
Iran	Eupeptic, stomachic, depurative, choleretic, laxative, low blood pressure, tonic and antipyretic	Whole plant	Did not declare
Italy	Blood purification	Leaves	Did not declare
	High blood pressure	Leaves	Decoction
	Blood purification, arteriosclerosis, anti-arthritic, antispastic, digestive	Leaves /roots	Decoction
	Depurative	spiral	Decoction
	Choleretic, hepatoprotective against jaundice, laxative, hypoglicemiant effect	Leaves	Decoction, fresh mashed leaves
Jordan	Internal hemorrhage, sedative in typhus	Whole plant	Cooked
Morocco	Kidney disease	Airy /roots	Did not declare
	Kidney disorders, diabetes	Whole plant	Decoctionl
Pakistan	Diabetes	Roots	Decoction
Poland	Digestive diseases and lack of appetite	Roots	Tea
Serbia	Diarrhea	Flower	Infusion
	Diuretics, digestive, laxative, anti-inflammatory, liver diseases, hypoglicemiant	Roots	Decoction/tea
	Cholagogue, digestive, hypoglicemiant	Aerial part /root	Did not declare
South Africa	Jaundice, tonic	Leaves, stems, roots	
Turkey	Cancer, kidney stones	Roots	Decoction
	Wound healing	Leaves	Ointment
	Hemorrhoids, urinary disorders	Aerial parts	Tea

Source: Street RA, Sidana J, Prinsloo G., (2013), Cichorium intybus: Traditional Uses, Phytochemistry, Pharmacology, and Toxicology

The studies on plants of the Cichorium genus have demonstrated many beneficial effects of the phytochemicals contained in the whole plant or parts of the plant, the potential utility and nutraceutical properties of the product, also providing a method to guarantee its authenticity at molecular scale (Girelli *et al*., 2021).

A study conducted in Turkey (Yasemin *et al*., 2017), on several chicory varieties, showed that the red chicory variety contained a higher amount of anthocyanins and more phenolic compounds, the total phenolic substances were more bio-accessible in the white chicory variety, and the antioxidant bio-accessibility was higher in the green chicory variety.

Together with the fructo-oligosaccharides, inulin stimulates the multiplication of beneficial bacteria in the intestine. Inulin and oligofructose are not digested in the upper gastrointestinal tract; therefore, they have a low caloric value. They do not lead to an increase in serum glucose and do not stimulate insulin secretion.

Inulin and oligofructose have more functional and nutritional properties, which can be used to formulate healthy innovative foods for today's consumer (Niness, 1999). Inulin has a much lower solubility, it improves the stability of foam and emulsions, and exhibits exceptional fat-like characteristics when used as a water gel. The replacement of fats and carbohydrates by chicory inulin and oligofructose offer the advantage of not compromising taste and texture, while providing nutritionally improved products (Franck, 2002).

Inulin, fructo-oligosaccharides and other oligosaccharides are included as fibre on US food labels. Studies have provided evidence that inulin and oligofructose (OF), lactulose and resistant starch (RS) meet all aspects of the definition, including stimulation of Bifidobacterium, a beneficial bacterial genus (Slavin J., 2013).

Table 2

Studies showing prebiotic effects of fibres in humans

Treatment	**Prebiotic effects**
Wheat dextrin	Increase of bacteria, decrease of *Clostridium perfringens*
Inulin	Bifidogenic
GOS	Bifidogenic
Guma Acadia	Bifidogenic
Psyllium	Prebiotic potential
Polydextrose	Bifidogenic
WG cereals for breakfast	Prebiotic potential
Banana	Fecal microbiota

Source: Slavin J., 2013

The inulin extraction process is similar to obtaining sugar from sugar beet. The conclusion of a study is that making coffee with chicory could use a lot of energy. Out of this reason, it is necessary to evaluate the whole process (while the

main attention should be focused on the most energy-consuming processes) and the techniques used to obtain the most efficient result. A case study in Latvia shows that drying and roasting temperatures are higher than in the similar chicory coffee factories, which could lead to a higher total energy consumption for the same production (Zane Indzere, 2018).

A case study analysed two scenarios based on new chicory varieties using new plant breeding technologies through New Plant Breeding Techniques (NPBT) and their impacts were compared with the reference scenario: the current commercial process of inulin from conventional chicory.

The new plant breeding techniques make specific changes in the plant DNA to modify its traits, and these changes can vary in scale, from changing a single base to inserting or removing one or more genes. The results of the study confirm that the genetical modification of the crop has a much wider positive impact on the entire production cycle, starting with improved chicory competitiveness in the European farmer's rotation cycle and resulting in wider positive economic and environmental effects for Europe. The study is incomplete from the perspective of the impact of inulin obtained from genetically modified plants upon human health, looking at the whole economic aspect: it can be imagined that the use of NPBT in chicory will impact human health by providing a more effective health-promoting ingredient such as inulin (Hingsamer *et al*., 2022).

Cichorium intybus could be successfully used in poultry and livestock farming due to its nutrition and pharmaceutical benefits. Various methods to combat diseases have been used in broiler chicken farming. A method often used was the use of antibiotics, resulting in the emergence of drug-resistant microorganisms, with negative effects upon human health. Alternative sources are currently sought for decreasing the number of pathogens in the gastrointestinal tract. Chicory can be used to deal with liver diseases in poultry and help replace antibiotics (Saeed *et al*., 2017).

The inclusion of high-fibre ingredients in diet is a possible strategy to improve the intestinal fermentation and have a positive impact upon the intestinal ecology, barrier and immunity for feeding piglets. The study highlighted that both the chicory root and the chicory pulp are sustainable and cheap ingredients to reduce bowel disorders in piglet weaning (Uerlings *et al*., 2020).

Lamb weight gain, the increase of slaughter live weight and carcass tended to be the highest in legumes and chicory and the lowest in plantago and ryegrass (Fraser and Rowarth, 1996).

Area, production and imports. Eurostat statistical data show a positive evolution of this crop, but in only a few Member states. In Romania, chicory is not cultivated. The area under chicory for processing in the EU was by 36% higher in 2021 as compared to 2016. The main producers are Belgium, the Netherlands, Poland and France (Table 3).

Table 3

Area under chicory for processing in the EU – thousand hectares

	2014	2015	2016	2017	2018	2019	2020	2021
EU-27	:	:	11.98	11.92	:	:	15.53	16.29
Belgium	:	6.29	6.01	6.54	8.41	8.89	9.16	9.73
The Netherlands	0.00	3.90	3.80	3.14	3.14	3.98	3.85	3.78
Poland	1.00	1.30	1.02	1.13	0.68	0.80	1.20	1.60
France	1.60	0.89	1.02	1.05	1.65	1.24	1.25	1.17
Spain	:	0.02	0.13	0.07	0.08	0.07	0.07	0.01

Source: Data extracted on 22/03/2023 10:54:46 from [ESTAT]

Chicory yield for processing in the EU was higher by 34% in 2021 than in 2016, and by 62% in Belgium that represents 66% of the EU production (Table 4).

Table 4

Chicory production for processing – thousand tonnes

	2014	2015	2016	2017	2018	2019	2020	2021
EU-27	:	:	551.98	559.58	:	:	689.59	739.36
Belgium	:	314.57	300.90	327.76	421.27	444.75	458.20	487.40
The Netherlands	0.00	170.40	172.20	152.64	136.45	171.89	144.43	162.00
France	74.56	42.86	49.28	47.66	77.71	0.05	55.23	52.29
Poland	32.20	28.60	24.12	29.13	14.10	17.00	29.20	37.40
Spain	:	0.81	5.48	2.40	1.51	2.53	2.53	0.27

Source: Data extracted on 19/04/2023 14:00:44 from [ESTAT]

According to Data Bridge Market Research, the chicory market (chicory roots, leaves, chicory flour, roasted chicory, chicory inulin, etc.) was evaluated at 693.56 million USD in 2021 and it is expected to reach 1,165.20 million USD by the year 2029. The industry of soft drinks, confectionery, frozen desserts and other uses are likely to create significant opportunities for chicory producers. Technological advances in manufacturing, the introduction of efficient purification systems, new substrates and the development of recombinant enzymes have led to lower production costs of chicory products.

Europe dominates the chicory market due to the growing consumption of chicory coffee, increasing health awareness among people and growing demand for sugar substitutes. The action plan on organic farming, presented by the Commission in March 2021 as part of the Farm to Fork Strategy, outlines a set of actions to increase organic farming in the EU. The trend in the imports of chicory and chicory products shows greater consumer interest. Organic chicory imports doubled in 2021 as compared to 2018 (Table 5 and Table 6).

Table 5

The main importers of organic chicory and imported production in the EU

Country	2018	2019	2020	2021
Belgium	192	322	388	376
France		31	18	11
Total general	192	353	406	387

Source: TRACES

Table 6

The main organic inulin importers in the EU

Country	2018	2019	2020	2021
Belgium			17	
Denmark	1		1	
France	5			0
Germany	140	257	54	63
Greece				31
Italy	21	2	25	8
The Netherlands	38	75	124	238
Slovenia		28		
Spain	21	40	20	5
Undefined	35			
Total general	261	402	241	346

Source: TRACES

Imports are entirely from India. Inulin imports increased by 33% in 2021 compared to 2018. More than 98% of imports originate from Mexico.

According to statistics, in the year 2021 Romania exported inulin (code 110820) in the amount of 1.1 thousand USD and imported inulin in the amount of 314 thousand USD.

5. CONCLUSIONS

In the tradition of many peoples, chicory is utilised for treating various ailments, and the studies on plants of the *Cichorium* genus showed many beneficial effects of the substances contained, for animal feeding inclusively.

Chicory is a crop that meets WHO recommendations for a healthy diet.

At present, the areas and productions of chicory for processing in the EU are increasing. There is a growing market for chicory products and extracts, which confirms consumers' interest in a healthier diet.

Although an extensive study highlights that chicory production obtained through new plant breeding techniques (genome modification) is more efficient than conventional production, the Farm to Fork Strategy aims to accelerate the

transition to a sustainable food system that should ensure food security, nutrition and public health. The positive evolution of organic chicory root and inulin imports come entirely from third markets, which shows that the development of organic production in the EU and in our country represents an opportunity for farmers.

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