Moreover, the *Rechtsausschuss* pointed out that Sec. 8 of the German Patent Act empowers the "Bundesregierung" to allow the use of an invention that is in the public interest. Consequently, there was no need to expand the possibility of compulsory licenses in order to compensate for the disadvantages of the patentability of food.[58]

Finally, the exemption was abolished in 1967. This was mainly because the fears and arguments concerning food, pharmaceuticals and chemical substances proved to be unjustified. Food was henceforth treated like any other area of technology. Utility models for food were now also admissible as a consequence of the patentability of food in the German Patent Act of 1967.[59]

IV. Consequences of the patentability of food in Germany

This section explains the consequences of the patentability of food in Germany measured by the number of patent applications regarding food-related inventions. Food biotechnology-related inventions constitute a particularly new field of technology and are therefore of special interest to this thesis. Therefore, food biotechnology-related inventions are also shown as a separate segment of food-related inventions. First, fields of inventions related to food and food biotechnology are defined in a technological and an economic sense. Technological classes that constitute food-related inventions in an economic sense are identified. Then the rise in food-related German patent applications as a consequence of the patentability of food is shown.

58 *Nastelski,* in: *Reimer* (ed.), Patentgesetz und Gebrauchsmustergesetz, 3rd ed., Köln 1968, 128.
59 *Nastelski,* in: *Reimer* (ed.), Patentgesetz und Gebrauchsmustergesetz, 3rd ed., Köln 1968, 1854.

Food in a technological and an economic sense is assessed by a linkage between the technology of food-related patent applications to the food sector in an economic sense. The International Patent Classification (IPC)[60] classifies all fields of technology. The Statistical Classification of Economic Activities in the European Community classifies the economic activities in all industrial sectors of the European Union. A concordance between these classifications is used to determine food-related patent applications.

Inventions belong to certain fields of technology. These fields are classified in the IPC system. The IPC is the basis for classifying patent applications worldwide and constitutes the internationally acknowledged standard classification for patent applications. Every patent application is classed in one or more classes of the IPC. One class of the IPC is designated the main class of the respective patent application. Additional classes are designated as secondary classes. Food-related patent applications are those patent applications with a food-related main and/or secondary class.

The IPC system has eight different sections.[61] Section A covers human necessities. Subsections of section A are agriculture, foodstuffs and tobacco, personal or domestic articles and health and amusement. Section A and its subsections are subdivided into 15 classes, which are again subdivided into subclasses.

Patent applications referring to agriculture matter most in the food sector. For this reason, the IPC subclasses of agriculture (A01), baking (A21), meat treatment (A22) and foods or foodstuffs and their treatment[62] (A23), are examined with respect to the amount of annual patent applications in each subclass. Furthermore, the relevant subclasses of biochemistry (C12) and the sugar industry (C13) are assessed.

60 The IPC is based on the Strasbourg Agreement Concerning the International Patent Classification, which was concluded in 1971 and became effective in 1975. The IPC system is open to the parties to the Paris Convention for the Protection of Industrial Property and was joined by 55 states in 2005, WIPO, 2005,
available at www.wipo.int/treaties/en/ShowResults. jsp?lang=en&treaty_id=11.
However, the industrial property offices of more than 100 states, four regional offices and the International Bureau of the WIPO under the Patent Cooperation Treaty (PCT) actually use the IPC, WIPO, 2004, available at www.wipo.int/classifications/-ipc/en/preface.htm. Few countries like the U.S., also use their own classification systems in addition to the IPC.

61 Section A: Human necessities; Section B: Performing operations, transporting; Section C: Chemistry, metallurgy; Section D: Textiles, paper; Section E: Fixed constructions; Section F: Mechanical engineering, lighting, heating, weapons, blasting; Section G: Physics; Section H: Electricity. According to IPC, 7th ed., available at www.wipo.int/classifications/fulltext/new_ipc/.

62 Patent applications which are covered by other classes are excepted by A23.

Patent applications relating to mechanical engineering are not considered in this statistical survey. Mechanical engineering plays an important role in the food sector, but it is not specific to the food sector because its inventions are usually applied in different sectors. Furthermore, the exemption, which is of special interest in this context, was limited to food-related substances.

The subclasses of IPC concerning food-related patents are chosen according to the Statistical Classification of Economic Activities in the European Community, the so-called NACE.[63] NACE uses criteria like technical specificities of the production process or the organization of the production process through chained industries. NACE aims at establishing a common statistical classification of economic activities within the EU in order to ensure comparability between the national and European classifications and hence national and European statistics. Technological and economic indicators are linked by a concordance between technology and industry classifications.[64] *Schmoch et al.* performed an empirical study to develop a concordance between the codes of the IPC and the industrial sectors defined by NACE codes based on data of 3,000 companies.[65]

Table 1 shows food-related technological IPC subclasses that have been identified using this concordance of IPC with the economic classification NACE.[66] The IPC title and examples according for the respective IPC subclass are listed in column 2 of table 1.[67] Moreover, the denomination[68] of the respective IPC subclass used in the following statistical survey is given in column 3 of table 1.[69]

The IPC subclasses listed in table 1 cover all technological areas relevant to the food sector in the economic sense, comprising baking, preserving and pasteurization, dairy, oil and fats, coffee, cocoa and confectionery, proteins, brewing, vinegar and alcoholic beverages, and sugar processing. The IPC subclass feed (A23K) is also examined, as

63 *Nomenclature des Activités dans la Communauté Européenne (*NACE) Rev.1. NACE is a derived classification in the family of International Classifications NACE Rev.1 - Statistical Classification of Economic Activities in the European Community, ISBN 92-826-8767-8, available at www.europa.eu.int/comm/eurostat/. This classification is very similar to the English SIC and the U.S. Standard Industrial Classification Manual, in: *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, available at www.isi.fraunhofer.de/p/Downloads/Microsoft%20Word%20-%20Report%20Technology%20Industry%20.pdf.

64 *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 16, available at www.isi.fraunhofer.de/p/-Downloads/Microsoft%20Word%20-%20Report%20Technology%20Industry%20.pdf.

65 *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003.

66 *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67.

67 IPC, 7th ed., available at www.wipo.int/classifications/fulltext/new_ipc/.

68 This denomination is used because the official title is often long and rather complex.

69 Field Definitions by IPC, 7th ed., in: *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67, available at www.isi.fraunhofer.de/p/Downloads/Microsoft%20Word%20-%20Report%20Technology%20 Industry%20.pdf.

feed-related processes and substances are a pre-stage of food production and thus are similar to those in human nutrition. Furthermore, there is the catch-all subclass A23L, which is labelled miscellaneous food because it contains those food-related patent applications which are not covered by A23B to A23J.

Food biotechnology-related patent applications are defined as patent applications whose main or secondary classes are both in the food-related IPC subclasses of table 1 and in the biotechnology-related IPC subclasses of table 2. Biotechnology-related IPC subclasses were defined via a concordance between technological and economic classifications according to *Schmoch et al.*[70] Biotechnology-related IPC subclasses are determined using pharmaceutically related subclasses as a basis and leaving out subclasses related to organic or inorganic chemistry. Table 2 shows the IPC title of the respective biotechnology-related IPC subclass in column 2.[71] Moreover, the denomination of a respective IPC subclass used in the following statistical survey is given in column 3 of table 2.

70 *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67.

71 IPC 7th ed., available at www.wipo.int/classifications/fulltext/new_ipc/.

Table 1:
Food-related technological subclasses of IPC according to NACE.[72]

IPC sub-class	Title and examples of the respective IPC subclass	Denotation
A01H	New plants and processes for obtaining them; plant reproduction	Plants
A21D	Treatment, e.g. preservation of flour or dough, e.g. by addition of materials; baking; bakery products; preservation thereof	Bakery
A23B	Preserving, e.g. by canning, meat, fish, eggs, fruit, vegetables, edible seeds; chemical ripening of fruit or vegetables; the preserved, ripened, or canned products	Preserving
A23C	Dairy products, e.g. milk, butter, cheese; milk or cheese substitutes; making thereof	Dairy
A23D	Edible oils or fats, e.g. margarines, shortenings, cooking oils	Oils and fats
A23F	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof	Coffee and tea
A23G	Cocoa; chocolate; confectionery; ice cream	Confectionery
A23J	Protein compositions for foodstuffs; working up proteins for foodstuffs; phosphatide compositions for foodstuffs	Proteins
A23K	Fodder	Feed
A23L	Foods, foodstuffs, or non-alcoholic beverages not covered by subclasses A23B to A23J; their preparation or treatment, e.g. cooking, modification of nutritive qualities, physical treatment; preservation of foods or foodstuffs, in general	Miscellaneous food
A23P	Shaping or working of foodstuffs	Shaping
C12C	Brewing of beer	Brewing
C12F	Distillation or rectification of fermented solutions; recovery of by-products; denaturing of, or denatured, alcohol	Distillation

72 Field Definitions by IPC, 7th ed., in: *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67.

Table 1 - continuation:
Food-related technological subclasses of IPC according to NACE.[73]

IPC sub-class	Title and examples of the respective IPC subclass	Denotation
C12G	Wine; other alcoholic beverages; preparation thereof	Alcoholic beverages
C12H	Pasteurization; sterilization; preservation; purification; clarification; ageing	Pasteurization
C12J	Vinegar; its preparation	Vinegar
C13F	Preparation or processing of raw sugar, sugar or syrup	Sugar
C13J	Extraction of sugar from molasses	Sugar
C13K	Glucose, invert sugar, lactose, maltose, synthesis of sugars by hydrolysis of di- or polysaccharides	Sugar

73 Field Definitions by IPC, 7th ed., in: *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67.

Table 2:
Biotechnology-related technological subclasses of IPC according to NACE.[74]

IPC sub-class	Title and examples of the respective IPC subclass	Denotation
C07H	Sugars, derivatives thereof; nucleosides, nucleotides, nucleic acids (DNA or RNA concerning genetic engineering, vectors, isolation and preparation)	Nucleic acids
C12N	Microorganisms or enzymes, compositions thereof, propagating, preserving or maintaining microorganisms, mutation or genetic engineering, culture media	Microorganisms
C12P	Fermentation or enzyme-using processes to synthesize a desired chemical compound or composition or to separate optical isomers from a racemic mixture	Fermentation

2. Rise in food-related German patent applications

The rise of food-related German patent applications indicates that the food sector has made frequent use of the possibility to patent food since the abolition of the exemption in 1967. Food-related German patent applications rose from 97 in 1970 to 535 in 2001 and thus have more than quintupled which is shown in table 3.[75] The maximum was 726 food-related patent applications in 1997. The decrease in the following years might be due to a database defect occurring when data from the respective patent offices have not yet been delivered. The most important technological developments in the food sector, first and foremost biotechnological developments are explained in part II.

a. Overview

Altogether there were 13,206 food-related German patent applications from 1970 to 2001. Miscellaneous food (A23L) ranked 1st, with a total of 4,054 applications, confectionery ranked 2nd, with 1,479 applications, and feed (A23K) 3rd, with 1,325 applications. Bakery (A21D), with a total of 866, preserving (A23B), with 865, and dairy

74 Field Definitions by IPC, 7th ed., in: *Schmoch et al.,* Linking Technology Areas to Industrial Sectors, Final Report to the European Commission, DG Research, Karlsruhe etc. 2003, 67.

75 The overview given in table 3 refers to national German patent applications. European patent applications with designation Germany are not included.

(A23C), with 837 applications had a similar amount of food-related German patent applications during the period from 1970 to 2001. This indicates comparable levels of R&D expenditures in these three segments. These highest ranking IPC subclasses have high degrees of processing in common and show that the food sector mainly concentrates on higher forms of processing and diversification.[76]

The most frequent subclasses in 1999 were miscellaneous food (A23L), with 235 applications, confectionery (A23G), with 83 applications, and feed (A23K), with 48 applications. Plants (A01H) rank 4th, with 41, shaping (A23P) ranks 5th, with 40 applications, and dairy (A23C), 6th with 36 applications in 1999, followed by bakery (A21D), with 34 applications, and preserving (A23B), with 31 German food-related patent applications in 1999.[77]

b. Dairy and confectionery

The food sector tends towards higher forms of processing illustrated by the increase of German patent applications in these subclasses. Dairy and confectionery have applied more and more sophisticated forms of processing. German patent applications in confectionery (A23G) have risen by 1,600%, and in dairy (A23C) by 500% from 1970 to 1999.[78]

The steadily increasing German patent applications in the dairy and in the confectionery segment reflect their economic importance within the food sector. The share of the dairy segment in the total turnover of the German food sector was 16% in 2005 ranking second, whereas the share of the confectionery segment in the total turnover of the German food sector amounted to 9% ranking 4.[79]

76 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 3. For the technological background see part II.

77 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 3.

78 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 3. For an overview of the technology see Table 11 and the explanations thereto.

79 Bundesvereinigung der deutschen Ernährungsindustrie, 2006, available at www.bve-online.de/.

c. Feed

Feed was the highest ranking subclass in 1970 apart from the catch-all IPC subclass miscellaneous food (A23L). Feed has never been excluded from patentability. Thus the feed segment of the food sector was already familiar with the patent system. German patent applications in feed (A23K) only rose by 280%, from 17 to 48 from 1970 to 1999.[80]

This increase in German patent applications indicates, that the feed segment has increased its R&D expenditures, but not as much as other segments of the food sector that involve higher forms of processing.

d. Plants

Though plant varieties have been excluded from patentability since 1967 according to sec. 2 para. 2 of the German Patent Act, patents on higher taxonomic groupings than a plant variety are obtainable.[81] Plants (A01H) rank 4th in the scale of overall patent applications with 41 German patent applications in 1999, reflecting the huge development of plant research.[82] Plants (A01H) did not have any applications in 1970 at all. Intense R&D activity has taken place since then, indicated by annually over 35 applications filed since 1999. Plants (A01H) is the only food-related IPC subclass that mainly represents the production of agricultural raw materials, while the other food-related subclasses are primarily involved in the production of processed food.[83]

80 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 3.

81 BGH, Usambaraveilchen, BlfPMZ 1974, 203. A detailed legal explanation follows in Part III section A subsection I.

82 For the technological background see part II, section A, subsection I.

83 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 3.

Table 3:
Food-related national German patent applications with priority from 1970 to 2001.[84]

Year	A01H	A21D	A23B	A23C	A23D	A23F	A23G	A23J	A23K	A23L	A23P	C12C	C12F	C12G	C12H	C12J	C13F	C13J	C13K	Sum
70	0	11	4	7	2	6	5	1	17	25	2	8	1	3	1	0	2	0	2	**97**
71	0	9	15	11	1	11	21	7	18	29	1	26	2	6	4	2	4	1	2	**170**
72	2	13	18	11	4	8	26	1	27	44	0	19	5	10	5	1	3	2	8	**207**
73	14	15	23	26	0	10	35	6	22	70	7	22	4	10	9	0	2	2	5	**282**
74	4	17	23	15	3	8	32	4	30	65	3	17	6	16	5	0	1	1	4	**254**
75	0	16	30	24	5	6	39	11	35	70	2	27	1	9	6	1	2	2	7	**293**
76	0	27	25	19	1	7	19	6	32	59	1	22	3	4	8	0	2	0	4	**239**
77	4	25	30	20	2	11	31	8	39	47	0	16	1	6	2	1	6	1	7	**257**
78	15	25	21	27	2	18	49	5	27	92	23	22	5	29	5	1	8	0	3	**377**
79	3	18	27	22	4	4	44	8	41	80	4	30	1	17	6	0	9	1	7	**326**
80	1	19	21	28	6	11	33	18	60	88	11	30	3	18	5	0	2	0	5	**359**
81	3	25	21	29	1	17	36	4	50	101	11	30	7	20	4	0	10	0	15	**384**
82	2	25	26	21	2	15	47	10	55	113	11	21	3	9	5	0	12	0	7	**384**
83	2	23	26	34	2	9	42	8	40	101	11	27	2	16	7	2	8	0	7	**367**
84	8	25	32	27	2	14	47	9	43	117	13	19	2	19	7	0	13	0	1	**398**
85	6	25	27	19	0	7	47	7	55	106	16	32	2	38	5	0	7	0	5	**404**
86	10	34	47	32	5	18	56	4	66	137	31	25	10	24	16	0	18	1	2	**536**
87	16	24	24	31	3	17	65	2	53	128	27	15	5	19	9	1	2	0	4	**445**
88	15	25	21	27	2	18	49	5	27	92	23	22	5	29	5	1	8	0	3	**377**
89	8	27	18	21	3	9	54	4	22	115	19	21	1	15	6	0	3	0	1	**347**

84 Food-related patent applications are the IPC subclasses of table 1. It is referred to the first priority date that is claimed by the respective German patent application. This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. PlusPat is the world's largest international patent database. It merges the EPO's worldwide collection with the USPTO, WIPO and Japanese patent information. It covers more than 50 million patent documents from 75 patenting authorities. Available at www.questel-orbit.com/EN/Prodsandservices/ PlusPat.htm.

Table 3 - continuation:
Food-related national German patent applications with priority from 1970 to 2001.[85]

Year	A01H	A21D	A23B	A23C	A23D	A23F	A23G	A23J	A23K	A23L	A23P	C12C	C12F	C12G	C12H	C12J	C13F	C13J	C13K	Sum
90	22	28	23	25	5	14	28	5	32	115	19	11	0	15	8	0	4	0	2	**356**
91	12	28	18	29	7	4	38	8	34	93	19	11	2	15	5	2	3	0	1	**329**
92	19	35	26	21	5	7	44	10	43	134	24	28	1	18	6	2	8	2	2	**435**
93	15	31	45	40	4	8	53	7	30	176	30	26	2	16	11	0	4	0	1	**499**
94	18	39	41	39	6	18	56	15	51	194	29	30	1	22	14	0	5	0	2	**580**
95	17	33	37	31	5	16	53	13	35	206	29	37	0	26	16	0	7	0	0	**561**
96	32	47	26	41	5	20	95	11	52	239	36	40	0	27	11	0	6	1	3	**692**
97	23	50	37	38	5	9	82	21	46	265	58	44	2	27	11	0	7	0	1	**726**
98	27	53	38	40	6	18	68	16	62	261	44	28	1	19	12	1	9	0	1	**704**
99	41	34	31	36	3	18	83	16	48	235	40	19	0	17	7	1	5	0	1	**635**
00	38	44	36	27	1	10	50	8	70	265	37	20	2	26	13	0	3	0	1	**651**
01	37	16	28	19	2	8	52	7	63	192	34	32	1	31	8	0	5	0	0	**535**
Total	**414**	**866**	**865**	**837**	**104**	**374**	**1479**	**265**	**1325**	**4054**	**615**	**777**	**81**	**576**	**242**	**16**	**188**	**14**	**114**	**13206**

85 Food-related patent applications are the IPC subclasses of table 1. It is referred to the first priority date that is claimed by the respective German patent application. This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. PlusPat is the world's largest international patent database. It merges the EPO's worldwide collection with the USPTO, WIPO and Japanese patent information. It covers more than 50 million patent documents from 75 patenting authorities. Available at www.questel-orbit.com/EN/Prodsandservices/ PlusPat.htm.

a. Overview

Biotechnology plays an important role in the food sector with 1,078 patent applications out of a total of 13,206 food-related patent applications over the period from 1970 to 2001 as shown in table 4.[86] The share of food biotechnology-related German patent applications in food-related German patent applications was 8.2% during the period from 1970 to 2001. This share has rather constantly risen and generally followed the development of food-related German patent applications. For the period since 1978, the low points of food-related German patent applications with 326 in 1979 and 329 in 1991, correspond to the low points of food biotechnology-related German patent applications with 8 in 1979 and 18 in 1991.[87]

Food biotechnology-related German patent applications rose from 0 in 1970 to 73 in 1999. Until 1977, there was only an annual maximum of 8 food biotechnology-related German patent applications, while in 1978 a significant amount of 55 food biotechnology-related German patent applications were filed. The number of food biotechnology-related German patent applications fluctuated until 1990, with a minimum of 9 in 1979 and a maximum of 56 in 1986. From 1991 on there was a rather constant rise in food biotechnology-related German patent applications, from 18 to its maximum of 76 in 2000 and fluctuating only to a minimum of 56 in 1997.[88]

This rise is due to the increasing influence of biotechnology in the food sector. Biotechnology has become an important tool in the food sector,[89] with molecular breeding and genetically modified plants in the production of agricultural raw materials, and genetically modified microorganisms for fermentation or synthesis of food additives in the production of processed food. An overview of the technological developments is given in part II.

86 The overview given in table 4 refers to national German patent applications. European patent applications with designation Germany are not included.

87 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

88 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

89 Other relevant applications areas of biotechnology are the "Red Biotechnology" in the pharmaceuticals sector and the "White Biotechnology" for industrial applications.

"Green Biotechnology" as plant biotechnology is called, has increased remarkably, from 0 German patent applications in 1970 to 35 in 2000 (IPC subclass plants (A01H). The first 10 plant biotechnology-related German patent applications were filed in 1978. This amount decreased substantially in the following years. Plant biotechnology-related German patent applications have been rising rather constantly since 1984, from 1 to over 30 from 1999 on. This corresponds to the pioneering research in plant biotechnology that took place around 1983.[90] The constant level of plant biotechnology-related German patent applications indicates a steady R&D level in plant biotechnology. This reflects the steady implementation of plant biotechnology and the future potential of plant biotechnology.[91]

Meanwhile, plant biotechnology makes up for the lion's share of food biotechnology-related German patent applications. Since 1999, plant biotechnology-related German patent applications have accounted for over 45% of all food biotechnology-related German patent applications. The proportion of plant biotechnology-related German patent applications in food-related German patent applications is remarkably high and is the highest compared to other segments of the food sector. This ratio rose rather constantly from 12% in 1984 to 100% in 1993, and has levelled off at around 90% since 1994. The vast development and the important role of plant biotechnology in the food sector is indicated by the rise of German patent applications in plants (A01H).[92]

90 *Zambryski et al.*, Ti Plasmid Vector for the Introduction of DNA to Plant Cells without Alteration of their Normal Regeneration Capacity, 2 European Molecular Biology Organization Journal 2143 (1983).

91 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

92 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4. For the technological development see part II, section A, subsection I.

c. Feed biotechnology

Feed biotechnology is an emerging technology of the feed segment. Feed biotechnology-related German patent applications appeared first in 1975 with 1 application and increased since then to a maximum of 24 applications in 2001, accounting for 38% of feed-related German patent applications. This share has been rather constant since 1993, at about 10%. Feed biotechnology has the second-highest share of food biotechnology-related German patent applications among food-related German patent applications after plant biotechnology. This corresponds to the strong presence in the industry of feed additives like the enzyme phytase and the essential amino acid lysine that are produced by genetically modified microorganisms in the feed segment.[93]

d. Biotechnology in other segments of the food sector

Further IPC subclasses with significant food biotechnology-related German patent applications are miscellaneous food (A23L), with 17, and bakery (A21D), dairy (A23C), confectionery (A23G), proteins (A23J), brewing (C12C), distillation (C12F) and alcoholic beverages (C12G) with fewer than 5 in 1999. Oils and fats (A23D), vinegar (C12J), and the sugar subclasses (C13F, C13J, C13K) have not had any food biotechnology-related German patent applications from 1999 to 2001.[94]

The share of food biotechnology-related German patent applications apart from plants and feed among food-related patent applications ranges between 25% in vinegar (C12J) as well as 20% in sugar (C13K) and 1% in coffee and tea (A23F) and in confectionery (A23G) during the period from 1970 to 2001. Proteins (A23J), with 11%, and brewing (C12F), with 17% also showed high shares.[95]

93 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4. For an overview of the technology see table 9, part II, section A, subsection I and part II, section B, subsection I.

94 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

95 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

The proportion of food-biotechnology related German patent applications in other segments of the food sector than plants and feed has been rather small. The proportion of food biotechnology-related German patent applications among the confectionery subclass (A23G) has been minimal. There have been only 11 food biotechnology-related patent applications in confectionery during the period from 1970 to 2001. So biotechnology plays only an inferior role in the confectionery segment, where microorganisms are used only to a limited extent.[96]

Segments of the food sector which employ fermentation by microorganisms show a high degree of food biotechnology-related German patent applications, with 25% in vinegar (C13J), 20% in sugar (C13K), 17% in distillation of fermented solutions (C12C), 13% in feed (A23K), and 11% in proteins (A23J) from 1970 to 2001.[97]

The increasing number of German patent applications in these IPC subclasses reflects the notable influence of biotechnology on the improvement of fermentation processes and on the synthesis of food additives. Moreover, biotechnology has led to a range of new food additives and new processes in the production of processed food, such as in the processing of the sweetener aspartame.[98]

96 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

97 This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit. For an overview see table 4.

98 For an overview of the technology see table 11 showing uses of enzymes in the production of processed food, part II, section B, subsection I.

Table 4:
Food biotechnology-related national German patent applications with a priority from 1970 to 2001.[99]

Year	A01H	A21D	A23B	A23C	A23D	A23F	A23G	A23J	A23K	A23L	A23P	C12C	C12F	C12G	C12H	C12J	C13F	C13J	C13K	Sum
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
73	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
75	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**2**
76	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
77	0	0	0	0	0	0	0	0	4	2	0	2	0	0	0	0	0	0	0	**8**
78	10	3	2	7	0	0	0	0	8	11	2	1	2	3	0	1	2	0	3	**55**
79	1	0	1	1	0	0	0	1	1	1	0	2	0	0	0	0	0	0	1	**9**
80	0	1	0	3	0	1	0	2	9	5	0	4	1	1	3	0	0	0	0	**30**
81	0	0	0	1	0	0	0	1	6	2	0	2	1	1	2	0	0	0	4	**20**
82	1	1	0	1	0	0	0	0	2	5	0	0	0	1	0	0	0	0	0	**11**
83	0	4	1	8	0	0	0	4	7	8	0	0	0	0	1	0	0	0	1	**34**
84	1	1	0	0	0	0	0	1	6	8	0	0	0	2	0	0	0	0	0	**19**
85	3	2	2	3	0	0	0	4	6	8	0	2	1	4	0	0	0	0	2	**37**
86	8	1	0	5	0	0	1	1	13	9	0	5	5	5	1	0	0	1	1	**56**
87	13	2	2	2	0	0	1	1	5	8	0	1	2	2	1	0	0	0	1	**41**
88	10	3	2	7	0	0	0	0	8	11	2	1	2	3	0	1	2	0	3	**55**
89	7	0	0	0	0	0	0	1	2	3	1	0	0	2	0	0	0	0	0	**16**

99 Food biotechnology-related patent applications are IPC subclasses of table 1 linked with IPC subclasses of table 2. It is referred to the first priority date that is claimed by the respective German patent application. This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit.

Table 4 - continuation:
Food biotechnology-related national German patent applications with a priority from 1970 to 2001.[100]

Year	A01H	A21D	A23B	A23C	A23D	A23F	A23G	A23J	A23K	A23L	A23P	C12C	C12F	C12G	C12H	C12J	C13F	C13J	C13K	Sum
90	19	1	2	2	0	0	0	1	3	4	0	0	0	0	0	0	0	0	0	**32**
91	7	0	1	1	0	0	0	0	3	3	0	1	0	0	1	0	0	0	1	**18**
92	18	7	2	1	0	0	0	0	1	10	0	6	0	1	0	2	0	0	0	**48**
93	15	1	0	2	0	0	1	0	3	19	0	5	0	0	1	0	2	0	1	**50**
94	17	4	2	6	1	0	2	1	7	15	1	3	0	2	0	0	1	0	0	**62**
95	16	4	2	2	0	0	2	2	5	21	1	0	0	1	1	0	2	0	0	**59**
96	29	5	0	1	0	1	0	1	8	24	0	2	0	1	1	0	0	0	2	**75**
97	21	3	0	2	1	0	1	0	6	16	1	1	0	1	1	0	1	0	1	**56**
98	22	4	1	1	1	0	1	2	9	17	0	4	0	1	0	0	0	0	1	**64**
99	33	1	1	2	0	1	2	5	9	15	1	1	0	2	0	0	0	0	0	**73**
00	35	2	1	0	0	0	0	1	14	17	1	3	0	0	2	0	0	0	0	**76**
01	32	0	0	0	0	0	0	0	24	10	0	1	0	1	0	0	0	0	0	**68**
Total	**318**	**50**	**22**	**58**	**3**	**3**	**11**	**29**	**171**	**253**	**10**	**48**	**14**	**34**	**15**	**4**	**11**	**1**	**23**	**1078**

100 Food biotechnology-related patent applications are IPC subclasses of table 1 linked with IPC subclasses of table 2. It is referred to the first priority date that is claimed by the respective German patent application. This data was collected by the author in cooperation with *Schmoch* in 2004 at the Fraunhofer Institute for Systems and Innovations Research in Karlsruhe using PLUSPAT, a database developed by Questel-Orbit.

The German food sector has performed well since the introduction of food patentability in 1967, corresponding to its increasing patenting activity since 1970, as shown in tables 3 and 4. Meanwhile, it has become one of the most important industrial sectors. The German food sector comprised 5,970 companies with over half a million employees in 2004. The sector's turnover increased from €116.9 billion in 1998 to €133.6 billion in 2005.[101] The domestic sales rose from €96.6 billion in 1998 to €104,2 billion in 2005 by 8%, whereas the exports rose from €20.3 billion in 1998 to €29.4 billion in 2005 by 45%.[102] The tremendous increase of the exports might be due to the influence of the common market within the European Union. The share of exports in the sector's turnover steadily rose from 17.3% in 1998 to 22% in 2005.[103] This indicates that the patentability of food introduced by the Amending Act of 1967 had a promoting effect on the food sector.

Falling prices for food and reduced shares of food in consumer spending indicate that patents on food have not limited food availability. Food prices have not increased since the patentability of food in 1967, as the share of food prices in consumer spending has been constantly declining from 16.7% in 1980 to 12.2% in 2004.[104] Falling food prices render the fears of the legislature of 1877 about negative effects of patents on food availability unjustified.

Moreover, the share of costs of agricultural raw materials in consumer food spending constantly dropped from 50% in the early 1970s to 26% in 2004 while margins of food trade and the production of processed food have steadily increased.[105] The declining share of agricultural products in consumer food spending is caused by the division of labor and an increased demand for processed food combined with complementary services. This again indicates that the patentability of food had a rather positive effect on food production and availability in Germany.

101 Bundesvereinigung der deutschen Ernährungsindustrie, 2006, available at www.bve-online.de/.
102 Bundesvereinigung der deutschen Ernährungsindustrie, 2006, available at www.bve-online.de/.
103 Bundesvereinigung der deutschen Ernährungsindustrie, 2006, available at www.bve-online.de/.
104 A representative basket of commodities with 24 food articles costs least in Germany compared to the European Nations amounting only to 80% of the European average in 2004. Landesbauernverband Niedersachsen, Nahrungsmittel in Deutschland besonders preiswert, press release of March 9, 2005, available at www.landvolk.net/3747.htm.
105 Informationsdienst Wissenschaft, Anteile der landwirtschaftlichen Erzeugererlöse an den Verbraucherausgaben für Nahrungsmittel in Deutschland leicht gestiegen, 2005, available at www.idw-online.de/pages/de/news97492.

V. Assessment of the exemption in Germany from 1877 to 1967

The exemption in the German Patent Act of 1877 has been a rather formal exemption. The economic need to protect the inventions of certain industrial sectors has generated case law to bypass the exemption. The exemption in the German Patent Act of 1877 was made a formal exemption by the Amending Act of 1891 and the *Kongorot* decision, which acknowledged the patentability of analogous chemical processes.

Special fields of technology should not be discriminated against by an exemption to patentability, because the patent system *per se* is neutral.[106] It aims at giving the inventor an incentive to disclose his invention and rewards him for doing so.[107]

106 The first economic study performed on the patent system in 1958 by the American economist *Machlup* for the U.S. congress concluded as follows: "No economist on the basis of present knowledge, could possibly state with certainty that the patent system, as it now operates, confers a net benefit or a net loss upon society. The best he can do is state assumptions and make guesses about the extent to which reality corresponds to these assumptions." *Machlup*, An Economic Review of the Patent System – Study of the Subcommittee on Patents, Trademarks and Copyrights of the Committee on the Judiciary United States Senate Eighty-fifth Congress, second session, Study No. 15, Washington, D.C., 1958, 79. In spite of this difficult economic evaluation *Machlup* summoned the four theories underlying the patent system as following, *Machlup*, *supra*, 19 ss. The "natural law" thesis according to which the inventor has a natural property right in his own ideas. The "reward-by-monopoly" thesis considers the patent grant as an equitable remuneration of the inventor for his intellectual property work performed for the benefit of the community. The "monopoly-profit-incentive" thesis considers patent protection as an instrument for the promotion of technical and economic progress. Finally, the "exchange-for-secrets" thesis justifies patent protection with the obligation of the inventor to disclose his inventive idea to the public as early as possible. All four theories have in common that they do not distinguish between certain fields of technology. Thus it can be concluded that the patent system should be neutral for all fields of technologies. *Beier* confirmed in 1970, that the reward-by-monopoly, the monopoly-profit-incentive and the exchange-for-secrets thesis theories still apply to the policy aims of patent protection in most parts of the world, *Beier*, Traditional and Socialist Concepts of Protecting Inventions, 1 IIC 328 (1970), *Beier&Straus*, The Patent System and Its Informational Function – Yesterday and Today, 5 IIC 387, 392 (1977). *Adrian* points out, that neutrality of the patent system is limited by immanent borders by constitutional law, ordre public and morality, *Adrian*, Patentrecht im Spannungsfeld von Innovationsschutz und Allgemeininteresse, Berlin 1996, 16. Again, there is no distinction between different fields of technology.

107 Motives for patent protection are technical, economic and social promotion by protection of intellectual property of the inventor, awarding of the inventor himself, stimulation of the economy and encouraging the disclosure of technical knowledge. For an oveview see *Beier*, Die herkömmlichen Patentrechtstheorien und die sozialistsche Konzeption des Erfinderrechts, GRUR 1970, 1, *Oddi*, TRIPS – Natural Rights and a "Polite Form of Economic Imperialism", 29 Vanderbilt Journal of Transnational Law 415, 417 (1996).