

Research, development and innovation in the Czech food industry – perspectives

Výzkum, vývoj a inovace v českém potravinářském průmyslu, perspektivy

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Abstracts: The interdisciplinary problematic of food safety and health protection is being placed increasingly into research programmes of financial means providers as well as from the governmental funds and private funds. Gaining new knowledge about the state of food industry research and development (R&D) base and about the research results transfer, it is possible to stimulate innovation trends cultivating the food market and the life style.

Key words: food research, development and innovation in the CR, trends in R&D, financial and human sources in R&D

Abstrakt: Interdisciplinární problematika bezpečnosti potravin a ochrany zdraví je stále více zařazována do výzkumných programů jednotlivých poskytovatelů finančních prostředků jak z veřejných prostředků, tak i ze soukromých zdrojů. Analýzou nových poznatků o stavu výzkumné základny potravinářského průmyslu a transferu výsledků výzkumu a vývoje (VaV) do podnikatelské praxe lze stimulovat inovační trendy a směry přispívající ke kultivaci trhu potravin a životního stylu.

Klíčová slova: potravinářský VaV a inovace v ČR, zaměření VaV, finanční a lidské zdroje VaV

The object of the analysis is the R&D (research and development) base of the Czech food sector. Generally, the leading institution for the research and development is the Academy of Science CR. Its Technology Centre (TC AS CR) is executing the function of the National Information Centre for European Research. The Technology Centre is working out analytic and perspective studies of R&D and innovation and it is involved in the transnational technology transfer. The Centre worked out the Green Paper of Research, Development and Innovation in the Czech Republic. This study is identifying significant barriers of R&D and innovation. They are *economic* (high innovation cost, economics risks, lack of information sources), *market* (small interests of costumers) and *knowledge* (lack of professional employees) (Klusáček et al. 2008).

As it follows from the European Innovation Scoreboard 2007 classification, the CR has slightly

improved its position. Measured by the value of the Summary Innovation Index, the CR occupies the 21st position from 37 countries (in 2005, the CR was placed on 26th position from 33 countries) (Kučera, Pazour 2008).

The actual project FutureFood6 coordinated by the UNIDO was conducted in the CR by the TC AS CR and it was aimed on establishing a Food Quality and Safety Platform in the CEE countries (Spain, Austria, Hungary, the Czech Republic, Slovakia, Croatia, Romania and Bulgaria). The project title was “Healthy and Safe food for the Future” and it was financed from the EC Sixth Framework Programme. The data based on technology survey and interviews in the CR illustrate the best rating for the Functional Food and Nanotechnologies. Consolidate technologies are systems providing information, including labeling systems, traceability, development and application of new packing systems. The food industry is play-

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ing a significant role in the economies of the CEEs countries. The Czech food industry presents a long tradition in the specific manufacturing branches but in the environment of quickly advancing food multinational companies, it is necessary to improve its competitiveness. The project Future Food6 has established the platform for further support of the positive trends in food industry focused on improving food quality, safety and health.

MATERIAL AND METHODS

Documents of the CR Government and the EU methodology of the R&D evaluation present the base of the papers:

- National Innovation Policy 2005–2010,
- Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and in comparison with the situation abroad, 2007, 2008,
- Methodology of R&D evaluation.

Main indicators of R&D evaluation were set according to the EU methodology:

- Outputs of R&D,
- Expenditure on R&D,
- Human sources for R&D,
- Fruitfulness of the Czech R&D teams in the EU programmes, (6th Framework Programme),
- Innovation potential.

The TC AS CR elaborated a survey of the starting situation and presumptions for the successful realization of R&D in the CR in the period 2009–2014. Professional commissions of the R&D Council of the Government of the CR proposed eight long – running basic R&D trends. The TC AS CR laid out as the base of the analyses 12 basic thematic R&D sectors. It could be supposed that these sectors will significantly contribute to the R&D and Innovation advancement and it is possible to expect scientific findings. Food sector was classed in these sectors.

The interdisciplinarity of food sciences is the problem for the evaluation of the R&D potential and for the elaboration of new proposals.

It follows from the evaluation of the TC AS CR in the Green paper:

(a) Outputs of R&D

As it follows from the analysis of R&D outputs of food sciences, the citation is lower. Food branches are not so significant in the field of patents. According to the international classification, the main number patent applications were supplied for the specializations: biochemistry, beer, spirits and vine.

(b) Human resources for R&D

Researchers of food sciences are according to the accessible professional classification included in researches in natural sciences and in agricultural sciences.

(c) Fruitfulness of Czech research teams in the 6th Framework EU

The Programme “Food Quality and Safety” was one of the important priorities of the 6th Framework. The participation of Czech research teams in this research priority was relatively high, but their financial participation was lower.

(d) Innovation potential

The economic importance of food branches and branches connected with the food production is decreasing. The share of gross value added and employment is stagnating or declining.

Expenditures on R&D

The analysis of expenditures is based on the Czech Statistical Office regular statistical survey on research and development in the CR based on the methodology for statistical indicators of the R&D used in the EU countries. The reason is the comparability of statistical data on the international level.

Governmental expenditures on the R&D in food, beverages sector are not so high, but this indicator is

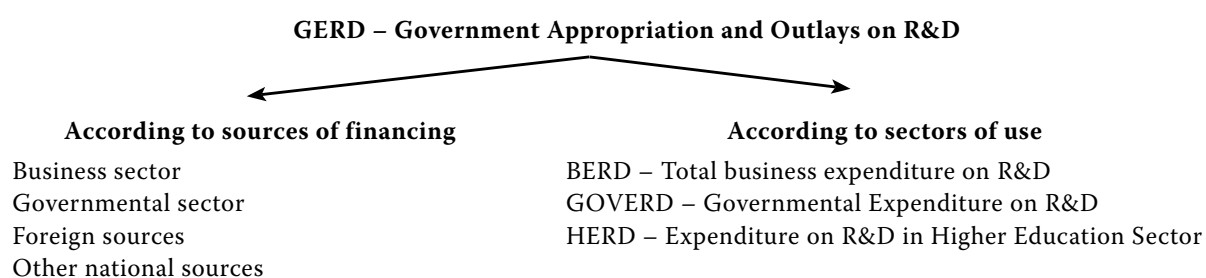


Figure 1. Government Budget Appropriations and Outlays on R&D

Source: CZSO

presenting a continuous increase in the last evaluated years. The biggest increase of public expenditures on the R&D in food, beverages sector was recorded in food technologies (in the period 2002–2004, the increase presented more than 150%).

The industry of food products, beverages and tobacco is according to the EU methodology classified as a low-tech industrial sector. The total intra-enterprise expenditures on the R&D in the food sector presented in 2007 about 1% of the total expenditures on the R&D in industry. It increased in the period 2000–2007 nearly 1.5 times (index 240) and the share of the food industry in total intra-enterprise expenditures of the industry total increased slightly from 0.8% to 1.0%. Data in absolute value documents in Table 1.

As it follows from the analysis of the Research and Development Council of the CR, the government continually increases the support for research and development from the governmental funds. The share of the governmental funds for the R&D of the Ministry of Agriculture (MoA) is oscillating around 3.84% in 2000–2007 (Table 2). A part of this support

is aimed at the food research and development and in this frame, on the quality and food safety.

Business sector represents an important share of the food R&D expenditures. The *R&D expenditures in the business sector* of food industry are in comparison with other manufacturing sectors very low. There is evident some progress according to this indicator.

Despite of the fact that the number of working places in the food sector increased from 19 to 51 units in the period 2001–2007, it represents only 5.2% of total industry workplaces (Table 3).

Figure 2 represents the R&D financing of food industry and manufacturing industry as a total. The main research activities are financed from own funds.

The expenditures on R&D realized in firms under foreign control (Table 4) have increased more rapidly in food industry (index 5.78) in the monitored period than in industry as a whole (index 2.61).

According to the statistical information of the CZSO on the direct governmental support of the R&D, the Government Budget Appropriations and Outlays on R&D (GBOARD) increased in the Czech

Table 1. Total internal business enterprise expenditures on R&D according to industries (economic activity) – CZ-NACE (CZK thousand)

NACE	Industry title (adapted)	2000	2005	2006	2007
01+02+05	Agriculture, forestry and fishing	57 426	82 091	97 695	115 586
15–37	Manufacturing total	10 600 882	17 145 359	21 951 938	20 511 550
15–16	Food, beverages and tobacco industry	87 964	193 018	193 018	211 109
01–99	Total Business Enterprise Expenditure on R&D (BERD)	15 881 873	27 208 641	33 023 287	34 647 997

Source: CZSO

Table 2. State support for R&D from the State Budget 2000–2007 (%)

Type of support/year	2000	2001	2002	2003	2004	2005	2006	2007
Share of MoA on R&D support from the governmental funds	3.8	3.77	4.12	4.18	4.53	4.4	4.23	3.84

Source: MoA

Table 3. Number of R&D workplaces by CZ-NACE of the business enterprise sector

NACE	Industry title (adapted)	2001	2005	2006	2007
01+02+05	Agriculture, forestry and fishing	17	14	21	21
15–37	Manufacturing total	509	858	965	980
15–16	Food, beverages and tobacco industry	19	39	52	51
01–99	Total number of R&D personnel (HC) in the business enterprise sector in the CR	885	1 617	1 734	1 766

Source: CZSO

Republic in the 2007 by 11.8% in comparison with year 2006.

The scientifics and research problematic connected with food production is classed into three socio-economic objectives:

- Chapter 04: protection and improvement of human health – 0405 Nutrition and food hygiene 78 042 thousand CZK, increase by 5.8%,
- Chapter 07: Industrial production and technology – 0710 Manufacture of food products and technology 16 078 thousand CZK, increase by 0.7%,
- Chapter 06: Agricultural production and technology – 0606 Food technology 140 531 thousand CZK, increase by 14.4%.

Human resources for R&D

The number of the R&D personnel in the business sector of food, beverages and tobacco industry was 272 persons in 2007 (Table 5) and it represents only 1.6% of the total R&D personnel in the business enterprise industry sector. The share of researches in the number of the R&D personnel presented in food industry in the year 2007 was about 40%, in the industry as a total, this indicator amounted to 42%.

Number of researchers in business enterprise sector by the CZ-NACE includes Table 6.

Qualitative analysis (summary of the important findings from the questionnaire research)

The qualitative analyze of the list of the R&D workplaces was compiled according to the information of the MoA, the Association of Research Institutions and the Committee of Food Sciences of the AS.

According to the indication of the Czech Committee of Food Science and Technology established by the Academy of Science of the CR, there were asked 38 subjects oriented on the scientific disciplines in the branch of food science. The responsible body for the development of food industry and for food science as well is the MoA.

The MoA supports the food research and development in the institutional and functional forms. The problematic of food research and development is solved in the frame of 6 research plans of five research institutions, mainly in the Food Research Institute, Prague.

Research teams of the technological, technical, medicine universities and firstly the research insti-

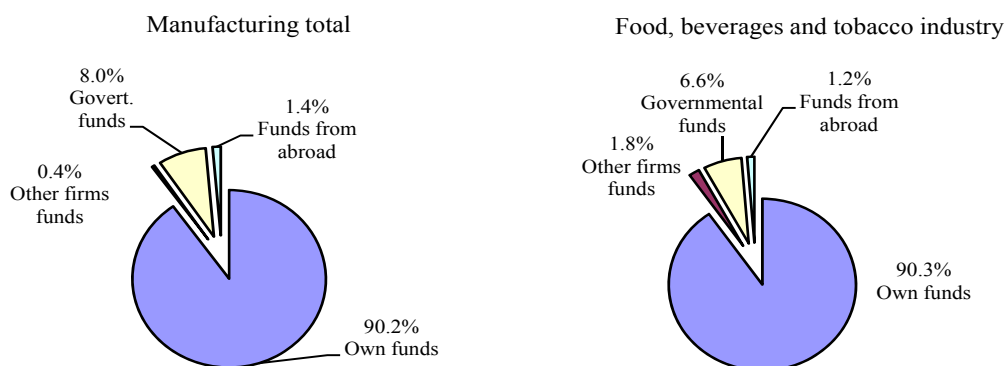


Figure 2. Business expenditures on the R&D by the main sources of funds and industries 2007

Source: CZSO

Table 4. Expenditure on R&D realized in firms under foreign control in the CR according to industries (economic activity) – CZ-NACE (CZK thousand)

NACE	Industry title (adapted)	2000	2005	2006	2007
01+02+05	Agriculture, forestry and fishing	16 042	22 161	15 959	18 127
15–37	Manufacturing total	5 315 373	11 339 622	15 729 237	13 877 786
15–16	Food, beverages and tobacco industry	25 915	86 902	131 370	136 828
01–99	Total expenditure on R&D in firms (BES) under foreign control in the CR	5 881 918	14 006 913	19 350 550	18 960 458

Source: CZSO

Table 5. Number of R&D Personnel in the business enterprise sector by the CZ-NACE – by December 31 (headcount)

NACE	Industry title (adapted)	2000	2005	2006	2007
01+02+05	Agriculture, forestry and fishing	192	183	242	210
15–37	Manufacturing total	12 178	14 242	16 389	17 409
15–16	Food, beverages and tobacco industry	81	195	232	272
01–99	Total number of R&D personnel (HC) in the business enterprise sector in the CR	21 599	27 708	30 216	32 379

Source: CZSO

Table 6. Number of researchers in the business enterprise sector by the CZ-NACE – by December 31 (headcount)

NACE	Industry title (adapted)	2000	2005	2006	2007
01+02+05	Agriculture, forestry and fishing	41	43	53	47
15–37	Manufacturing total	4 664	5 527	6 552	7 356
15–16	Food, beverages and tobacco industry	32	90	95	112
01–99	Total no. of researchers (HC) in the business enterprise sector in the CR	9 309	12 300	13 412	14 815

Source: CZSO

tutes of agriculture and health resorts are involved in solving problems connected with the problematic of food quality and safety.

The main part of the food research and development is concentrated at the Faculty of Food and Biotechnological Technology (Institute of Chemical Technology, Prague) and in the department's research institutes: the Food Research Institute Prague and the Veterinary Research Institute, Brno. The research aimed on the problematic in the particular branches of food industry is performed in the MILCOM, Plc., the Dairy Research Institute and in the Research Institute of Brewing and Malting, Plc. Medical faculties of universities are mainly aimed at the education field of healthy nutrition, as the National Institute of Public Health. The faculties of agricultural universities are mainly oriented on research and development in the field of agricultural raw materials for food production.

According to the expectation, all 4 inquired R&D institutes in the governmental sector answered the questionnaire. Only one organization from the high education sector filled in the questionnaire. The total return rate of the research is 26.3%.

In the evaluation of the realized questionnaire research, it was useful to review the R&D interviewed workplaces according to the sectors of financing in three groups, sectors of R&D: Governmental, Business and High Education sector.

The questions were basically aimed at:

- Resources of the research projects solving (financial resources, human resources),

- Co-operation of research workplaces with business units in the CR and abroad,
- Detailed survey of the contemporary priorities of food research,
- Possibilities of research workplaces engagement in the international research programmes and projects, international comparison.

RESULTS AND DISCUSSION

The results of the questionnaire evaluation confirmed the interest to respond mainly of the research institutes from the governmental sector.

Governmental sector

1. Basic information on the R&D workplaces

- Three of the research institutes are employing 100 and more R&D employees; one research institute is classified in the category 50–99 employees. He category “researchers” presents in these institutes 36–70% of all employees.
- The basic field of research is the animal production, plant production, veterinary medicine and food industry. Research activities of the institutes are focused on all nine NACEs of the manufacturing of food and beverages.

2. Research

- As the dominant type of *research activity*, there is mentioned the applied research (90–100%). Research

activities in the basic research are representing maximally 10%. In one case, there is mentioned the share of the innovation activity (5%).

- *Publication activities* of research institutions in the governmental sphere are aimed at the specialized impact international periodicals as the reviewed periodicals. All participants listed in detail their publication activity.
- Any from asked research institutes does not expect research focus in horizon 2014.
- *Financial and human sources* in future:
Financial sources: two from the interviewed institutes regarded the financial sources amount given for research as insufficient. The suggestion for the possible changes: according to the answers, it is necessary to increase the amount of financial funds from the EU, from governmental sector and from the private sector.
Human resources: all asked research institutes agreed to the necessity to support in the future young researchers both scientifically and financially.
- *Participation in international research programmes*:
7th Framework of the EU: three of research institutes are participating
Other participation: programmes: Cost, Contact, EFS, SAFOODERA
- *The opinions on the research results realization*: research institutes are cooperating mainly with Czech food manufacturing enterprises. The cooperation with food manufacturing enterprises with foreign capital or with foreign food manufacturing companies is only partial.

Business research and high education sectors

1. Basic information on the R&D workplaces

According to the presumption, it is evident that research institutions within the food business research sector are employing a lower number of employees and the share of researchers in the total number of employees is lower. It represents 15–50% of all employees.

2. Research

- Applied research is mentioned (90–100%) as the dominant type of research activity. Research activities in the basic research are representing maximum 10%. In one case, there is mentioned the share of innovation activity (5%).
- *Publication activities* of research institutions in the business research sphere are aimed mainly at the reviewed periodicals.
- Any from asked research institutes does not expect research focus in horizon 2014.
- *Financial and human resources in future*
Financial resources: two from the interviewed institutes regarded the financial resources given for research as insufficient. The suggestion for the possible changes: as in the governmental research sector, there is mentioned the necessity of increasing the EU funds for research.
Human resources: there is mentioned the necessity of the financial stabilization of research workers.
- *Participation in international research programmes*
Only one of the asked research organization mentioned the participation in international research programmes.
- *Opinions regarding the research results realization*
The interviewed research institutes are cooperating mainly with Czech food manufacturing enterprises, the cooperation with food manufacturing enterprises with foreign capital or with foreign food manufacturing companies is only partial.

It was not possible to evaluate the results of research in the high education sector regarding to the only one active responder (Table 7).

The obtained results are corresponding with and verifying the results of the TC AS CR (Klusáček et al. 2008). Food industry in the Czech Republic with regard to the labour force development was analysed by authors (Putíčová, Mezera 2008). As it follows from the conclusions, the future development of the Czech food industry will also dependent on the efficient utilization of various support forms as structural funds and other financial resources.

Table 7. Participation in the questionnaire search

Sector of R&D	Number of the contacted workplaces	% of total	Number of the answered questionnaires	% of total
Governmental	4	10.5	4	100.0
Business	23	60.6	5	21.7
High Education	11	28.9	1	9.1
Total	38	100.0	10	26.3

Source: UZEI

CONCLUSIONS

The aim of the research is to analyze, according to the accessible sources, the disciplinary differentiated R&D and innovation base in the Czech food industry and, on the ground of new knowledge, to contribute to transferring it to the business sphere and to overcoming of the barriers of this process.

It is important to pay more attention to the problematic of education and improvement of the quality of human resources. The Czech food industry cannot be dependent only on the traditional technologies. It is necessary to break ground for a faster and more efficient implementation of innovation, mainly new technologies connected with the safety and healthy food and the consumer protection. Factors influencing consumer behavior and purchase decision were solved in Stávková et al. (2008).

According to the results, it is important to pay more attention to:

- Support priorities of the R&D in the food research with regard to the possibilities of internal financial and human resources.
- Support the activities of the Czech food research institutes to take part in the international research programmes (Food for Life, etc.).
- Gain more possibilities to take part in the EU financial funds for research.
- Pay attention to the problematic of education and improvement of human resources .
- Call for a wider range of scientific problematic in the frame of the R&D competition of tenders.

The problematic of the food sector economy is solved in the frame of the Research Plan ZE0002725101 “Analysis and Evaluation of Possibilities of the Sustainable Agriculture and Rural areas in the Czech Republic in conditions of the EU and the European Model of Agriculture” (IAEI).

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