The Slovenian food composition database

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1. Introduction

Slovenia is a relatively small country in central Europe, although its nature is very diverse. Its natural conditions and social factors affect the diversity of its produce, as well as the variety of foods that are traditionally prepared and consumed. A wide selection of traditional foods has been maintained that are regularly consumed and are traditionally prepared and consumed. A wide selection of traditional foods has been maintained that are regularly consumed and are traditionally prepared and consumed.

Guerrero et al. (2010) showed that European consumers perceive a traditional food product as one that is produced with little processing involved and following a strict heritage, which is seen to be healthy and convenient. The raised awareness and appreciation of such products can also give rise to imitations, which can be prevented by the protection of a product through the Specific European Union (EU) Quality Scheme (Council Regulation [EC] No 509/2006, 2006; Council Regulation [EC] No 510/2006, 2006). As with other EU countries, the number of Slovenian food products that qualify for the protection of a product is growing. Currently, there are 16 Slovenian food products that are registered and can be labelled as Protected Designation of Origin, or PDO, Protected Geographical Indication, or PGI, or Traditional Speciality Guaranteed, or TSG (DOOR database, 2012). Although the compositions and characteristics of such foods are well known, a search for these data can be time consuming, as they must be sought from different, and often very specific, sources; i.e. the product specifications.

Food composition databases (FCDBs) provide comprehensive information on energy values, nutrients content, and other nutritionally important components in food. These data are essential for research into the relationships between diet and disease, for nutritional labelling, and for the monitoring of the quality, safety and authenticity of foods on the market, and thus for consumer protection (Church, 2009; Pennington, 2008). Users of data collected in food composition tables and databases are very diverse, and include researchers, clinical dieticians, public health officers, nutritional policy makers, the food industry, and educational facilities. National FCDBs that include data on traditional and ethnic foods are of high value as they can supply more accurate nutritional information on individual diets as well as they can aid effective diet and disease interventions in the population (Costa, Vasilopoulou, Trichopoulou, Finglas, & Pac, 2010).

Studies on the composition of various foods of the Slovenian ecosystem have been conducted at the Department of Food Science and Technology of the Biotechnical Faculty (University of Ljubljana, Ljubljana, Slovenia) since 1974, and the results have been published in peer-reviewed journals, dissertations, and laboratory and project reports. Despite the relatively large amount of analytical data obtained and the need for national food composition tables that was expressed by nutritional professionals, it was not until 2001 that a systematic analysis of samples, and the data collection for the creation of the database started, with the first project on the development of a preliminary Slovenian FCDB. In a survey that was part of the project activities, Slovenian nutrition experts and the food industry were asked to identify the sources of the food composition data that they used in their studies. Several reported that they used different editions of the Souci–Fachmann–Kraut Food composition...
and nutrition tables (Souci et al., 2000), while others said that they sourced their data from editions as old as the tables on the composition of food and beverages of Brodarec (1976). On the basis of these survey results and from comparisons of labelled nutritional information with analytical data of selected food products, the nutritional labels were often found to be less reliable.

The preparation and compilation of Slovenian FCDB is being realised mainly in the framework of Target research programmes' projects. The working group from the Biotechnical Faculty in Ljubljana is coordinating the activities, which have included experts from the Jožef Stefan Institute (Ljubljana, Slovenia) as the main project partner, along with other national research institutions.

2. Development of a preliminary food composition database

In the first stages of the food composition activities, the inventory included the actual food composition data with the components analysed, the methods used, and the data providers, with the quality of these data assessed. Physico-chemical analyses of selected domestic food products were carried out, although often to reduced extents due to limited resources.

This preliminary FCDB was prepared following international recommendations (Greenfield & Southgate, 2003) and the instructions of Central and Eastern European Food Data Systems (CEEEFOODS) initiative. Among the main tasks of the initiative were provision of a network of national data centres, generation of a repository of national FCDBs and promotion of national food composition programmes (Holcikova, 2000). Data management software that was developed for the purpose of the initiative was used for the creation and compilation of this FCDB (Vargic, Holcikova, Simonova, Kovacikova, & Vojtassakova, 1998). Food indexing with a 20-digit coding system was adopted, along with the Alimenta nutritional software (Holcikova et al., 1998). These were applied to enable the exchange of these data among the CEEFOODS countries. This preliminary FCDB comprised 230 different foods and beverages that are produced in Slovenia, along with 90 components. For the majority of these foods, the information on the proximate content and energy was provided, while data on fatty acids, amino acids, organic acids, minerals and vitamins were only rarely provided. The values for proximate content in randomly selected foods were also compared with data from other tables and databases (McCance & Widdowson, 2002; Souci et al., 2000; USDA National Nutrient Database for Standard Reference, 2012), with a satisfying analogy seen.

Later, the data in the FCDB were revised several times, and low-quality data were discarded (e.g., unknown source, disputable analytical method). The values for crude fibre were replaced with data on soluble, insoluble and total dietary fibre content. The energy values of the foods in the FCDB were recalculated when the directive on nutrition labelling for foodstuffs (Commission Directive 2008/100/EC, 2008) introduced energy conversion factor for dietary fibre.

3. Slovenian food composition tables on meat and meat products

A comparison of food composition data of Slovenian meat with data from the literature showed that there is wide variation, in particular in the total fat content, fatty-acid composition, and cholesterol content. This data variability thus underpinned the continuation of these food composition activities with a focus on meat and meat products. As meat of Slovenian origin accounts for the largest share of the meat consumed in Slovenia, the exact knowledge of its composition is also essential from the nutritional point of view. Within the framework of the project 'Slovenian food composition tables – meat and meat products (V4-0116)', different types and cuts of meat and meat products were sampled directly from the producers or the slaughter houses, and across retail outlets. For the meat, representative parts of the animals were selected, including shoulder, back, leg, and thigh. As well as the principal nutrients, fatty-acid composition, nutritionally important minerals, and cholesterol and hydroxyproline contents were also determined, using standardised, internationally recognised methods. Missing values (mainly for amino-acid and vitamin contents) were completed by taking data for these foods from non-Slovenian FCDBs where similarities in the other known parameters were seen. Due to the greater similarities between Slovenia and other European countries, such as for climate and animal breeds, only accessible FCDBs of European countries were considered in these data compatibly assessments (McCance & Widdowson, 2002; Souci et al., 2000).

The values obtained from physico-chemical analyses were thus complemented with data from other sources and were arranged into the Slovenian FCDB. These data were prepared in book format for dissemination: ‘Slovenian food composition tables – meat and meat products’ (Golob et al., 2006). This contained the compositional data on 145 foods, which were divided into the major food groups, as meat and products from: cattle, poultry, game, fish, crustaceans, and molluscs. These foods are indicated by both their Slovenian names and the English equivalents, and where relevant, also with their scientific names. The data refer to 100 g fresh meat or meat product, and they are presented as average values and range (minimum and maximum values). Where relevant, the edible part of the food is also given. All adopted data are indicated, and their sources are cited in the Reference section. The Tables are also available online.

4. Slovenian food composition tables on foods of plant origin

The plant varieties and the conditions of a product are known to affect the contents of the components it contains (Burlingame, Charrondiere, & Mouille, 2009). Thus, the aim of the project ‘Slovenian food composition table – foods of plant origin (V4-1047)’ has been to obtain analytical data on the compositions of foods of plant origin that are indigenous to, or characteristic of, Slovenia, and are economically important and widely accessible to the Slovenian consumer. An a priori list that comprised produce of indigenous plant varieties and food specialities was compiled (Table 1). Fruits, vegetables and olive oils were sampled in different locations in Slovenia, from markets, farms and manufacturers, and from the retail trade. The botanical origin and production location of each sample were carefully recorded to provide the relevant indicators for the biodiversity of the food composition data (Stadlmayr et al., 2011). All of the samples were analysed raw (prior to any processing), taking into consideration only their edible parts. In foods that are commonly consumed cooked, part of the samples were thermally processed prior to further analyses (boiled in plain water or baked in an oven, without the addition of fat). The physico-chemical analyses involved gravimetric, chromatographic, and spectrophotometric methods, and included the determination of the contents of protein, fat, the soluble, insoluble and total dietary fibre, ash, minerals, Ca, K, Cl, S, P, Na, Fe, Mo, Mn, Zn, Cu, Br, Sr and Rb, malic and citric acid, fructose, glucose, sucrose, lactose, molybdate, vitamin C, and fatty acids. In olive oils and table olives, only the fat, fatty acid and phytosterols compositions were determined. The data obtained will be integrated into the current Slovenian FCDB. Compatible data from other FCDBs will be adopted to fill the gaps in the information, such as for starch and some amino acids and vitamins.

Different types of bread and other cereal products were also sampled and analysed. These included several breads and bakery
products that are typical of Slovenia and that cannot be found in neighbouring countries (Table 1). These also represent the key food group contributor of Na (35.0%) in the nutrition of Slovenians, followed by meat products (27.8%), processed vegetables (6.6%), and cheeses (5.3%). The nutritional data obtained about these breads and bakery products are therefore of national importance, as the salt intake of the population assessed by 24 h urinary sodium excretion is particularly high; it has recently been estimated to be 11.30 ± 4.90 g/day (Ribic Hlastan, Zakotnik Maucec, Vertnik, Vegnuti, & Cappuccio, 2010). High sodium content can also be found in sauerkraut and pickled turnips, which are major components of many Slovenian traditional dishes. Therefore these two types of locally produced processed vegetables were included in the priority list and analysed for their proximate and sodium content.

### 5. The Slovenian food composition database and EuroFIR

The Network of Excellence (NoE), European Food Information Resource (EuroFIR) was a five-year FP6 project where one of the objectives was to develop a single European online platform with up-to-date food composition data. The sustainability of the platform of inter-connected national and specialised FCDBs was achieved through the foundation of the non-profit international association of EuroFIR AISBL (Association Internationale Sans But Lucratif). Further integration and refinement of the EuroFIR Food Platform in Europe is one of the objectives of the FP7 EuroFIR Nexus project, and implementation of European food data standards and promotion of the use of standards and best practice is another (http://www.eurofir.net/about_us/projects). Support is provided for the establishment and compilation of the regional FCDBs for the Balkan region. These activities are coordinated by the Institute for Medical Research in Belgrade, which also provides capacity-building training for FCDB compilers in the region (NCDN-CEE, http://www.agrowebcee.net/ncdn/objectives/).

When Slovenia joined EuroFIR NoE in 2008, the new European standards for food preparation and development of databases and tables were applied (CEN/TC 387, 2009). The national FCDB was reorganised prior to the further development and documentation of new data. Specific indexing systems were established to prevent errors that can occur in data interchange or use due to food names and descriptions, which might be ambiguous (Church, 2009). A multi-lingual thesaurus system known as LanguaL™ (http://www.langual.org/) that is used for the indexing of foods in most European countries was also adopted in Slovenia at that time. Before this, a 20-digit coding system was being used that had been agreed upon by members of the CEECFOODS network for the harmonisation of the national FCDBs of the network partner countries (Vargic et al., 1998). All of the foods that were entered into the Slovenian FCDB before 2008 were therefore re-indexed, to be compatible for communication with different parties using the EuroFIR Web Services, which also provided support for data exchange among the members of the regional FCDBs of the Balkan region.

The Slovenian platform was designed according to EuroFIR standards and enables correct data coding and communication with the EuroFIR platform and other platforms, directly via the internet.

### 6. The Slovenian food composition database and nutrition software

In 2008, we started a project to create Optijed, a publicly accessible web application for meal planning (Korosec Seljak, 2009). This was the first Slovenian web application that used the Slovenian FCDB. The Optijed application has been well received among its professional users, and was recently replaced by updated and upgraded web application 'Open Platform for Clinical Nutrition' (OPEN, http://opkp.si/en_GB). OPEN is primarily used for dietary assessment and is freely accessible via the internet. After logging in, users can search for nutritional information on foods in the Food Lexicon (Fig. 1), track and assess their nutrition through My Food Diary, and create a personalised diet using My Diet Planner. However, OPEN also represents the electronic format of the national database and the Slovenian node in the EuroFIR virtual information platform. Currently, it includes data on the compositions of 620 different foods and dishes from Slovenia:

- 145 meat and meat products;
- 7 types of Slovenian honey;
- certain types of wines and spirits;
- ready meals;
- more than 200 dishes, with recipes for their preparation.

The compositional data include measures of the content of proximate, different minerals, carbohydrates, fatty acids, amino acids, organic acids, ethanol and some higher alcohols, and vitamin C. These data are based on analytical values from analyses that were performed in the laboratories of the Biotechnical Faculty of the University of Ljubljana, and they have been completed, where necessary, with values taken from relevant foreign FCDBs. A total 150 components are included.

As stated in the European report (2005), the success of the nutrition policy is greatly dependent on that how well people are informed on the positive effects on their health of healthy eating. The internet and the advances in information and communication technologies have broadened the availability of the FCDB, and the number of users has expanded. The use of modern electronic devices supported by modern information and communication technologies has opened up new possibilities for the development of applications for food composition data use: e.g. BaToo (Bar Recognition Toolkit), which informs the user about potential allergens in food through the identification of International Article Number

| Table 1 Sampling priority list of produce of Slovenian autochthonous and traditional plant varieties, and traditional food products. |
|-----------------|-----------------|
| **Plant species** | **Variety** |
| Lettuce (Lactuca sativa L. conv. sativ. var. capitata L.) | Ljubljanska Ledenka |
| Corn salad (Valerianella locusta) | Ljubljanski; Žičar |
| White cabbage (Brassica oleracea L. ssp. oleracea conv. capitata (L.)) | Kranjsko okroglo |
| Bush bean (Phaseolus vulgaris L. ssp. vulgaris var. vulgaris) | Češnjevcev |
| Potato (Solanum tuberosum L.) | Kresnik; Cvetnik |
| Oilseed pumpkin (Cucurbita pepo L. var. oleifera sin. var. citrinula (L.) Greb. var. styriaca) | Slovenská golica |
| Onion (Allium cepa L. var. cepa) | Ptujška rdeča |
| Apple (Malus domestica Borkh.) | Carjevič; Kanadška reneta |
| Sweet cherry (Prunus avium L.) | Vipavka; Terčentka |
| Peach (Prunus persica L.) | Veteran |
| Olive (Olea europea L.) | Istraška belica |
| Buckwheat (Fagopyrum esculentum (Moench)) | Čebelica |
| Millet (Panicum miliaceum L.) | Sonček |
| Field mustard (Brassica rapa L. var. rapa) | Kranjska podolgovata |

Food products

- Bread from mixtures of flours with lower salt contents
- Buckwheat bread
- Rye bread
- Sauerkraut
- Pickled turnips
(EAN) codes, and a German smart-phone application that serves as a food diary (Bell et al., 2011). Another example of such a device is a kitchen scale with an integrated Bluetooth module that wirelessly communicates with OPEN, to provide support for chronic patients with special nutritional needs, such as diabetic patients and those with the need for carbohydrate (or any other nutrient) counting. The wireless communication between the scale and OPEN can run over a smart-phone or a tablet (Korousic Seljak & Papa, 2009).

7. Conclusions

The Slovenian FCDB is prepared in electronic format. The database platform was created according to the recommended standards, and it supports web services and represents a tool for communication with EuroFIR and other platforms. The data in the Slovenian FCDB are based primarily on analytical values of the composition of foods and food products of Slovenian origin. With the realisation of the current project 'Slovenian food
composition table – foods of plant origin [V4-1047], the number of food items in the national database will grow to about 800. Data obtained within the previous projects will be complemented with current information on the composition of various fruits, vegetables, olive oils, cereals and cereal products that are traditionally grown and produced in Slovenia.

However, this national Slovenian FCDB will not be complete. The data for some individual food groups will still be missing (e.g. milk and dairy products, beverages). These might be obtained from relevant institutions in the framework of the future activities of the Slovenian FCDB. Assimilation of the data from nutrition declarations on food products is anticipated as well. Indeed, there has been great interest by the Slovenian food producers for re-analysis of the nutritional values of their products due to the adoption of new EU regulations on providing information to consumers. Furthermore, Slovenia has a wide range of traditional foods, food products and dishes, for which the full compositional data need to be generated.

Although the significance of the development and compilation of the national Slovenian FCDB has often been questioned, the solid results of our studies and the involvement in the EuroFIR activities has helped to raise the awareness of policy makers. The provision of this Slovenian FCDB with foods from our territory is an important tool that has several purposes: it enables insight into the nutritional value of foods of domestic origin, along with the monitoring of their quality; it provides information on the compositions of traditional foods and dishes and of foods that are typical to Slovenia; and it promotes the development of quality standards for products that will wish to carry EU quality distinctiveness labels (e.g. PDO, PGI, TSG). The data included are also important for the Slovenian food industry for product labelling, and for more accurate results of dietary studies carried out in Slovenia and internationally. With this national, high-quality, Slovenian FCDB we can also contribute to the understanding of food biodiversity.

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