Images in Data Bases

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Abstract

Food composition data base developers have available to them technology which permits the incorporation of images, in addition to standard numeric and descriptive data. For maximum usefulness, the images should be used to document the samples as collected and/or prepared (e.g., after cooking, reconstituting); to verify expanded descriptions (e.g., sample maturity); to identify with scientific names, for the present and the future as they can change; and to accompany the numeric and descriptive data into user applications' software packages. Presently there are over 200 food images in the New Zealand Food Composition Database, ranging in size from 25 KB to more than 2 MB each, and occupying a total of about 80 MB of disk space. The process at Crop & Food Research involves digitizing photographs of the actual food samples using an optical scanner at 400 dpi resolution. Other technologies in use include archiving using CD-ROMs; fractal compression with its resolution-independent images, color preservation and extreme compression ratios (600:1); and documenting new samples using a digital camera. To date, several important uses for images have emerged. These include identification of some finfish species, where the common name could relate to several different scientific names; data validation where intensity of the orange color led to accepting ß-carotene values outside the expected range; food intake surveys where food descriptors were difficult to translate, such as lean:fat ratios in beef cuts; more complete capture of details from food packages, including batches and barcodes; and for international interchange of food composition data. The process is so simple, and the information so valuable, that there is little reason to omit this important step in food composition work.

Documentation by Image

Ideally, images should be used starting at the sample collection stage. In New Zealand, food samples are collected and assembled in the laboratory. Samples are first photographed intact and raw with appropriate cross-sections exposed. The samples are often photographed again after consumer-type preparation. A scale definition (usually a metric ruler) and a color index panel (usually a Pantone sheet) are also included in most photographs.

Food packaging and labels are also routinely photographed, allowing capture of barcodes, batch codes, and other coded and cryptic information. All this is done in addition to the recording of word descriptors and detailed text containing the standard documentation details such as age of sample, date of sampling, geographic region, common and scientific name, physical state, processing, packaging materials, etc.

The photos are then digitized in a PCX format using an optical scanner at 400 dpi resolution. Much higher resolution is available, but there is a trade-off between resolution and space required to store the image. Presently, there are approximately 200 PCX images in the NZ Food Composition Database, occupying about 80 MB of disk space. The size of the individual files ranges from 25 KB for a simple black and white bread wrapper, to 2 MB for some large, highly colored fruit and vegetable images. Disk space requirements vary depending on size of the image, number of colors, the image resolution and the compression technology used.

Various manipulations can be done to achieve efficient storage. One NZ beverage record represents a composite of three different brands of powdered drink mix. The packaging scanned in 256 colors occupies 630 KB; this same file compressed with PKZIP occupies 416 KB; and as a GIF file, 93 KB. The same information contained on the packaging, when entered into the database as text, occupies a mere 30 bytes. Figure I shows disk space comparisons of three food records, as full color PCX files, greyscale PCX files, compressed (ZIPped) full color PCX files, PCX files converted to GIF and JPG, and information captured as plain textual descriptions.

Using a number of different software package and shareware, images stored in PCX format can be transferred to media as other less byte-consuming formats such as GIF. This is important because users will have different hardware and software products available to them. GIF and TIFF have become industry standards, and JPEG with the ISO and CCITT backing (1) is becoming popular for compressing still images for storage. Exchanging of images will be facilitated by having image format flexibility.

The Hardware

The ability to view images is dependent on the hardware available. Images require, as a minimum, a Super VGA monitor which can display 1024 x 768 pixels in at least 256 colors. Some images require a 1 MB video card capable of displaying 32,000 colors from a palette of over 16 million colors. These hardware items are widely available and in common use around the world.

Other media

Flopticals have been used already in the exchange of images between New Zealand and INFOODS. Floptical disks are 21 MB in size, compared to the 1.44 MB size of standard 3.5" disks. Although this capacity is helpful, other media are required for exchanging data bases full of images, and this is where compact disks become essential. Third party software will allow integration of compact disks and proprietary technologies such as Photo-CD with food composition data bases. Many information systems have been developed using CD-ROM technology. Conventional information retrieval techniques including full-text searching and relational databases are integrated for accessing information stored on the CD-ROM.

Limitations

There are some limitations with using images in food composition data bases. For example, an image cannot be searched in the same way as text files. The image of an artificially sweetened beverage will identify ingredients, one of which may be aspartame. However, the image files cannot be searched for the presence of aspartame the way a descriptor text files or code files can. This is one important reason why images will not substitute for documentation by words or alphanumeric codes.

Uses of Images

Data Validation

Verification of information has become the most valuable use to date of the effort to document by images. Analysts and compilers of data bases sometimes question data, and images have on many occasions allowed us to make decisions about accepting or rejecting the results of some nutrient analyses. For example, very high values for ß-carotene in New Zealand apricots were questioned a few years after the analytical work. More recent work on apricots produced values which were significantly lower. We examined details of methods, compared the sampling plans and sample preparation methods, and finally resolved the problem by comparing images of the actual samples used. The images showed that the earlier samples had a much deeper, darker, orange color than the more recent samples. Another example of data verification involves the New Zealand muttonbird. Its iron content is higher than that expected for a bird, and resembles the iron content of beef and lamb. The image shows the flesh of this bird is a deep red color, suggesting that the high level of iron is not unreasonable.

Food Intake Surveys

It is often difficult to match an item in a diet history or recall survey with an equivalent record in a food composition data base. Even in an interview situation where the foods are selected off a computer screen, some judgments are required which many people cannot make without the benefit of visual examples. It is far easier for most people, nutrition professionals and lay alike, to select a picture which looks like what they would consume. For example, most people could not say with confidence what the ratio of separable lean to separable fat was in the piece of meat they ate, although lean:fat is a common descriptor used in food records.

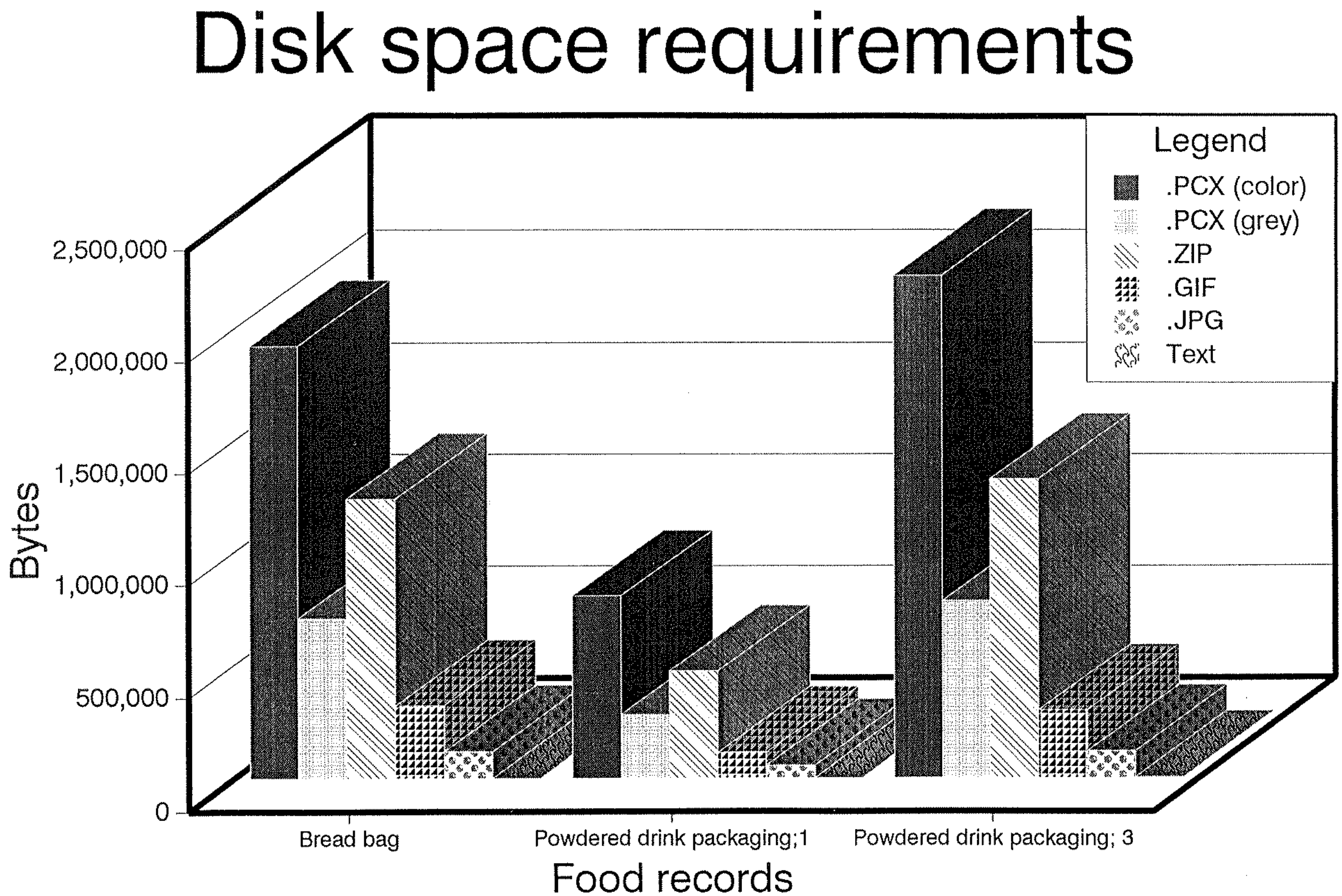
International Interchange

International interchange of food composition data, and more importantly, international trade in food products, reveals the challenge of relying on word descriptors. However comprehensive and however many language translations are provided, words alone will never be enough. Every country has unique items in its food supply and food composition data base. New Zealand has feijoa, pukeko and karaka berries; Australia has witchetty grubs, walleroo and cassowary gum. Most people outside of the region would have no idea what these foods are.

Even more challenging than unfamiliar-sounding foods, are familiar-sounding foods which are remarkably different from their like-named counterparts. For example, the New Zealand kumara, with the alternative name sweet potato, is quite unlike the North American sweet potato; the New Zealand pumpkin is unlike the typical North American pumpkin. The differences seen in the nutrient composition are not so surprising when the physical differences are shown with an image of the food.

INFOODS has considered the issue of images in food composition databases (2), and an image element is included in the interchange model (3). The structure for interchange using the INFOODS' model requires elements that indicate the picture encoding type as well as providing the actual image. A comment element may also be used. The images are subsidiary to the classification element, which is the first immediate subsidiary of the food element. Images associated with a cut of meat record might include a carcass diagram showing the position of the cut and a photograph of the cut itself. These would be included in an interchange files as follows:

<image><pcx/> *the first image itself in PCX format* </pcx/><cmt/>beef carcass diagram with cut sites identified</cmt/></image>
<image><gif/> *the second image itself in GIF format* </gif/><cmt/>image of cut</cmt/></image>



Disk space requirements
Legend
.PCX (color)
.PCX (grey)
.ZIP
.GIF
.JPG
Text
Bytes
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Bread bag
Powdered drink packaging;1
Powdered drink packaging; 3
Food records

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References

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