

## Archaeobotany in prehistoric graves – concepts and methods

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Plants played an important role both in the everyday life of prehistoric societies and as grave deposits in the burial of their dead. This article focuses on the latter aspect, which is a neglected field of research in Sweden, and discusses the possibilities of finding and identifying fossil plant remains in graves. These remains may have survived in various forms: as macro-remains (diaspores) that can be observed by the naked eye, or as micro-remains (phytoliths, cell structures and pollen) visible under a light microscope or scanning electron microscope. The fossil plants can also form a part or the main content of prepared food, charred bread loaves, or food encrustations on pottery, for example. These concretions can be analysed chemically to trace the vegetal content of the food involved. The analytical methods used at the Archaeological Research Laboratory are also discussed here. Our main goal is to try to interpret the function of the plants in the grave as ritual, symbolic and /or utilitarian. Since the plant remains deposited in the graves were probably chosen for a certain purpose, comparisons with remains found in settlements will also be important for deducing their function.

### Introduction

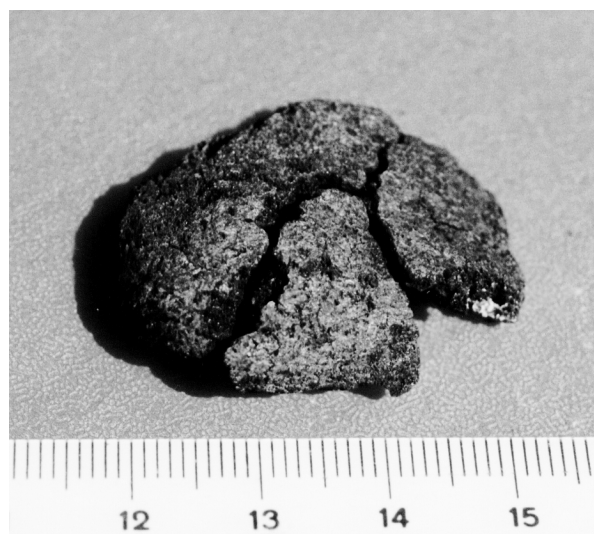
The physical and metaphysical characteristics of burials, the external and internal grave morphology, grave gifts and cremation or other ritual treatment of the body after death, are all expressions of a symbolic language which reveals information not only on the deceased's age, gender and social rank, but also on attitudes towards his or her role in the afterlife, attitudes which can be either of a more corporal or a more spiritual kind (Bennett 1987:195f). The fossil plant remains found in graves are also bearers of such information, and their role, whether as symbols, ritual markers, food, decoration or functional containers, may also vary with time. We must be aware of the contribution that archaeobotanical grave analyses can make towards our understanding of burials as the material embodiment of religious activity, expressed as a symbolic text written in a language that we must learn to decipher.

Archaeobotanical material has mainly been recorded previously from spectacular graves that have prompted extremely detailed excavation or graves where special conditions caused the plant material to survive in subfossil form. Examples are the ship burials at Sutton Hoo, England (Bruce-Mithford 1979), and at Oseberg, Norway (Holmboe 1927).

In Sweden, the archaeological plant material that survives comes mostly from cremation graves, where carbonization in the funeral pyre provides for its preservation. Plant material from coffin or chamber graves seldom survives. Furthermore, since the climate in Scandinavia is cold and moist and the permeable soils encourage aerobic conditions, ideal habitats exist for destructive micro-organisms. Thus the plant remains that

survive in Swedish graves are often only a part of the original deposit.

In order to achieve a proper interpretation of the function – ritual, symbolic, utilitarian, and/or other – served by plants in prehistoric graves, it is important to begin with an overall view of plant deposition in burials. It is also necessary to examine whether this material reflects the living society and thus socio-



*Figure 1. Carbonized organic concretion, bread (B8) from the Black Earth, Birka, Björkö island, Lake Mälaren. Photo: Ann-Marie Hansson.*

Table 1. The botanical remains found in prehistoric graves can be divided into three groups. These remains can be analysed in terms of their morphology and also chemical compounds. Various methods used to identify and interpret vegetable remains are presented in this table. The references (different from those in the text) direct the reader, where possible, to researchers not connected with ARL.

	<i>1. In soil</i>	<i>2. In bread and organic concretions of unknown origin</i>	<i>3. On (in) artefacts, i.e. ceramics, food utensils</i>
<i>Morphological analyses</i>	Analysis of fossil plant remains Robinson & Siemen 1988, Viklund 1998*  Phytolith analysis Lalueza Fox et al. 1996, Golyeva 2000  Pollen analysis Whittington 1993; Tipping 1994; Clarke 1999; Lagerås 2000  Thin section analysis Håkansson 1995*	Cell structure analysis Hjelmqvist 1984, 1990; Rosendahl; 1909, 1912a, 1912b  Phytolith analysis –  Starch analysis Rosendahl 1912a,b; Samuel 1994  Pollen analysis –  X-ray Währen 1984  Image analysis Währen 1984	Cell structure analysis Isaksson 1996  Phytolith analysis –  Starch analysis –  Pollen analysis –
<i>Chemical analyses</i>		FTIR analysis Isaksson 1999*  Chemotaxonomic analysis Brockner & Mitchell 1994*  Geochemical analysis trace metals: Bethell & Smith 1989* phosphates: Farswan & Nautiyal 1997*	FTIR analysis Isaksson 2000, paper VII  Chemotaxonomic analysis Gustafsson 1994, Donkow 1995, Isaksson 1996  Geochemical analysis Wojnar Johansson 2001*

\* Methods that could be used to identify plant material in graves, but were performed here on other material or on material from other contexts.

– = No published analysis of this material known to the authors.

economic and religious changes that have taken place over time. The contribution of archaeobotany to the study of graves and burial deposits has until now been poorly represented in the archaeological debate. This is now beginning to change.

## Methods

There are several methods available for finding archaeobotanical material in graves and for identifying the fossil plant record in its various forms, as prepared food, raw material for food preparation, or otherwise. The source material falls under the headings of (1) soil, (2) organic concretions and (3) artefact accretions, which provide a useful division of the material for the presentation of methods that can be used for examining these (table 1).

(1) It has proved fruitful to analyse the soil from cremation graves when searching for fossil plant remains. The soil in graves contains much more information about archaeobotanical grave gifts than can be observed by the naked eye, requiring chemical

analyses as well as botanical-morphological analyses of plant cell structure, e.g. in the form of phytoliths.

(2) Organic concretions are often found in graves (e.g. loaves of bread, see fig. 1). The concretion can originally have been bread, for instance, or faecal material or pitch. Sometimes the morphology clearly indicates the correct origin, and this can be further established by identifying the contents.

(3) Accretions on or within the fabric of artefacts. Food matter may sometimes accumulate on items of pottery, utensils and the like, and these encrustations can be removed and analysed in the same way as other organic material. Along with the microfossils, scrape marks on grinding stones etc. can provide evidence of the handling and processing of food and tell us how the artefact was used before it was laid down as a gift in the grave.

Most of the methods that have been used to analyse these groups of material were originally developed for use on other types of

archaeological material or material from other contexts. The various chemical, histological and morphological methods used to identify fossil plant remains in general are discussed by Hillman et al. (1993).

The following methods are in use at the Archaeological Research Laboratory (ARL).

### *Morphological analyses*

Morphological studies begin with an examination of the whole concretion. Sometimes the outer form may give sufficient information as to the original substance. More penetrating analyses concerned with content morphology can reveal the plant components. These include studies at the cell structure and phytolith level.

### **Analysis of fossil plant remains**

A special excavation technique for grave material is often used at ARL which has been developed under the guidance of Professor Birgit Arrhenius. The whole cremation layer is transported to the laboratory and sieved in water indoors, with simultaneous flotation of the layer or selected parts of it. This method has proved very successful, and we often find smaller fragments of both artefacts and ecofacts which would otherwise have been lost in traditional field trowelling (Seiler 2001:32f). All fossil seeds and fruits and other identifiable material are examined under a stereomicroscope at a magnification of 10x or higher. If the seeds are difficult to examine because of adhering soil, they are washed in 48% HF for a few minutes. The identification process makes use not only of the recognized reference literature but also of the laboratory's detailed reference collection of modern seeds and fruits, built up by Ann-Marie Hansson over the years.

### **Cell structure analysis**

Cell structure analysis is performed by bleaching and then dissolving a small sample from the interior of the loaf or vessel. A slide is prepared, so that the ingredients can be identified and documented under a light microscope. The cell layers that are diagnostic for the different varieties of cereals are identified under a light microscope, or else a scanning electron microscope can be used if greater magnification is required (fig. 2).

### **Phytolith analysis**

Phytoliths, the silica depositions that form in and between the living cells of vascular plants, do not decompose in the same way as other parts of plants, and often the durable phytolith is the only part of a plant to survive. Remnants of plants, especially grasses, can be traced in this way even in cases where no remains have been carbonized – as in soils from inhumation burials. This method involves isolation of the phytoliths from soil samples with the aid of chemicals, after which the material is identified and counted statistically under a light microscope, and finally documented photographically. The results are correlated with those of geochemical analyses (see below) in order to isolate anomalies occurring in different areas in the grave, which can cast light on how the grave was built up and where the grave gifts were deposited. Plant remains in the abdominal area of the de-

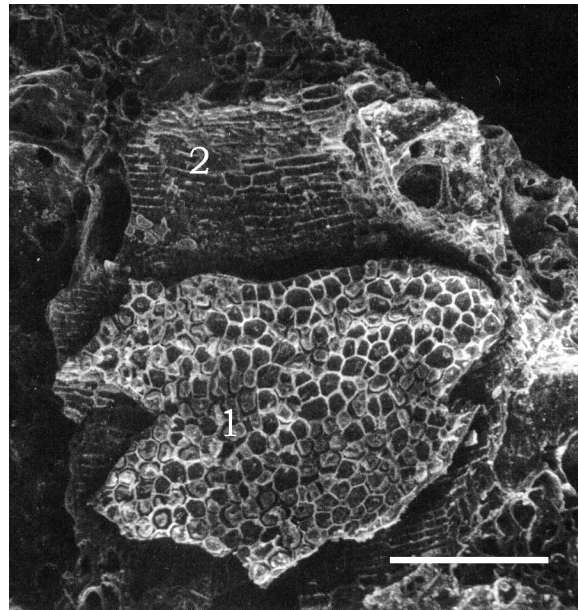


Figure 2. Preliminary morphological analysis of a Birka loaf (B8), bar 20µm, showing cell layers. (1) Aleurone layer and (2) underlying layer of transverse cells from wheat (*Triticum* sp.). Scanning electron micrograph by Liselotte Bergström and Ann-Marie Hansson.

ceased and botanical remains in vessels can also be analysed by this method.

Phytolith analysis can provide a deeper knowledge about plant occurrences in archaeological contexts at two levels, first based on a division into morphotypes, which does not allow correlation of the analysis results by species but does highlight the differences between the samples being examined (Powers 1992:29), and second, based on a comparison of the archaeological material with modern samples (e.g. of cereals) in order to improve the identification of plants to species or genus (Powers 1992:30).

A special method that was developed and tested during the analysis of soil samples for phytoliths at ARL (Bergström 1996) has now been applied to soil from two inhumation burials. The results clearly show that the soil lying next to botanical deposits in a grave leaves qualitatively and/or quantitatively different phytoliths from the soil in the rest of the grave (Bergström 2000a, Bergström 2000b).

### **Image analysis**

It is also possible to study porosity and to establish from the morphology of the bubbles whether a bread loaf had been leavened or not (Hansson 1994:17). We hope in the future to study the porosity of Swedish prehistoric grave bread by image analysis and systematize the results to obtain a better grasp of early bread making.

### *Chemical analyses*

Chemical analyses may be useful both as a complement to morphological analyses and in their own right, as they can provide information on a taxonomic level with regard to residues of vegetal matter laid down in a grave. They can also provide more gen-

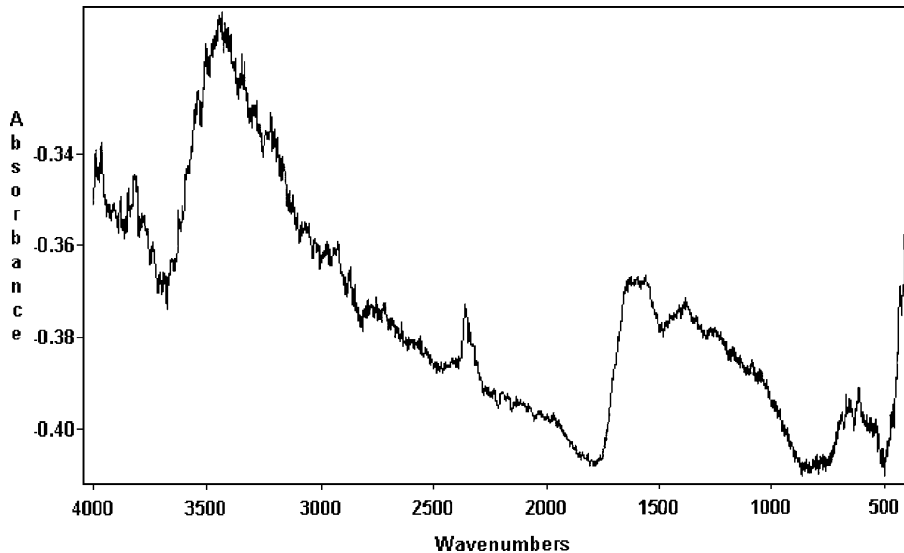


Figure 3. FTIR diagram of the Birka bread (B8). The IR spectrum is a graph with wave number on the x-axis and absorbance on the y-axis. Each peak in the spectrum represents a chemical bond or functional group. The intense, broad peak at about  $3400\text{cm}^{-1}$  reflects the prominent presence of O-H and O-N bonds, indicating carbohydrates and O-N bond proteins. A peak around  $1650\text{cm}^{-1}$  indicates a protein rich material. By Ann-Marie Hansson

eral information on the build-up of layers and structures within the grave, and also differential gift deposition within the same grave or between graves.

#### Fourier transform infrared spectrometry (FTIR)

Sometimes archaeological excavations of graves and settlements produce burnt concretions of organic material that have lost their original shape, and these finds are often lumped together with other unidentified objects under the heading "miscellaneous" in catalogues of finds.

There are now numerous complementary methods for characterizing small pieces of burnt organic material – whether they be fragments of bread or organic residues adhering to potsherds. Encouraging results have been obtained in new studies at ARL concerning the use of FTIR analysis (fig. 3), a method first introduced to the laboratory in a different context by Dr. Sven Isaksson (cf. Sandelin 1998; Isaksson 1999; Isaksson 2000 paper VII; Hansson 1999, 2000a,b; Hansson et al. 2000). Isaksson (1999:35) groups these substances according to their naturally occurring chemical compositions, such as bituminous material, waxes, oils, fats, carbohydrates and proteins (cf. Kemp 1991; Isaksson 2000). Residues from foods whose main original constituents are carbohydrates, proteins and fats form a major group, to which faecal material is closely related, although it is sorted into a separate group by FTIR analyses.

FTIR is a relatively quick method which requires minute samples of the order of 0.1 mg. This means that it is possible to perform chemical analyses on a large range of samples, since the damage caused to the archaeological source material by sampling is minimal.

FTIR analysis is used as a first means of sorting. If the material can be identified as bread or bread-like, more elaborate methods may follow in order to obtain more detailed information about the vegetal content. At the analysing stage, the IR spectrum is used as a chemical fingerprint whereby comparison is made with standard samples and/or previously analysed samples stored in a reference database. The database at ARL contains spectra derived from

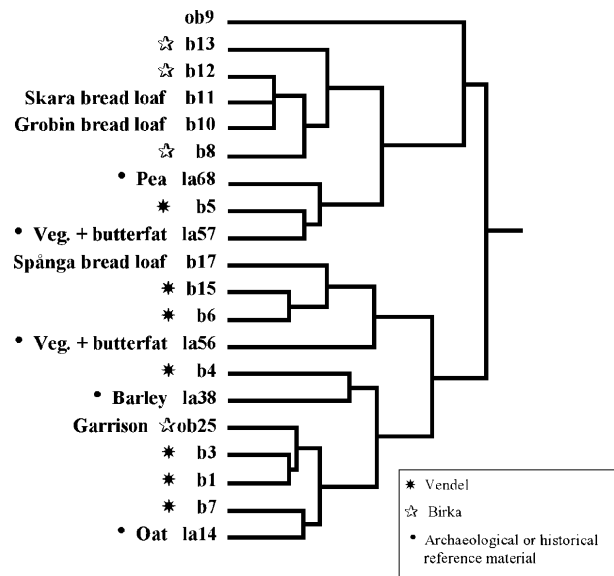


Figure 4. Part of a correlation matrix for samples from loaves of bread and organic concretions of unknown origin. The samples formed a special group in which FTIR analysis pointed to a similar chemical context in all cases. The graph includes the loaf (B8) from the Black Earth of Birka. By Liselotte Bergström and Ann-Marie Hansson.

identified modern material, experimentally decomposed modern material, and a variety of identified archaeological materials. The hierarchical cluster method is based on the distance obtained when measuring similarity (see Isaksson 1999:37), the results of the analysis showing degrees of similarity between samples, i.e. identical samples will have exactly matching spectra (fig. 4).

#### Chemotaxonomic analyses

GC/MS and other technical equipment are used at ARL to extract information on the chemical components in organic samples, such as carbohydrates, proteins and lipids.

So far only a very few such analyses have been performed on

bread loaves (cf. Hansson & Isaksson 1994:26), which makes it difficult to interpret the results at present. The major problem concerns storage conditions. For a good result, especially for lipid analyses, the samples should be frozen as soon as possible after excavation.

The porosity of unglazed pottery allows lipids to be absorbed into the fabric of the vessel during its use as a food container. Such lipids can survive for a long time. Thus lipid analyses performed on pottery sherds from a number of prehistoric graves have shown the presence of vegetable (contra animal) biomarkers, indicating pure vegetable products or mixtures of animal and vegetable products (Isaksson 2000, paper VII:21).

### Geochemical analyses

#### (i.e. metal trace elements and phosphate)

Much useful information can be gleaned by combining the results of the various methods of archaeobotanical morphological analysis with those of inorganic component and element analysis. Geochemical analyses can trace anomalies in the graves (Bergström 2000a, 2000b), and trace element analysis can provide information on ingredients, which is especially informative with regard to bread research (Hansson 1995c:46).

### Fossil plant remains at burial sites in Sweden

We know that prehistoric societies made considerable use of plant material of different kinds in their daily lives and their burials. The following ecological and functional groupings can be suggested for the Swedish grave material:

#### 1) Cultivated plants

- 1a) Raw materials (cereals, oil and fibre plants)
- 1b) Products (bread, porridge or grain-paste, textile fibres)

#### 2) Wild plants

- 2a) Raw materials
  - i) Edible plants (roots, berries, fruits and nuts)
  - ii) Plants used for other purposes
- 2b) Products (wood in coffins, tar sealings, birch-bark containers)

Examples of each of these groups found in Swedish prehistoric burials will be presented below. Since most of the analyses, and thereby most of the results regarding archaeobotanical material in Sweden, refer to Iron Age cremation burials, most of the examples concern material found in Iron Age graves. We have taken examples from older material as well whenever possible, however.

#### 1. Cultivated plants

Cultivated plants are known to have been used as burial gifts, both in the natural form of grain, seeds and fruits, and in prepared forms, i.e. as bread loaves or clothing.

##### 1a. Raw materials (cereals, oil and fibre plants)

Until the 1980s, we owed almost all our knowledge of prehistoric cultivation in Sweden to the analyses of Professor Hakon Hjelmqvist (1955, 1979), who studied imprints of cereals and other seeds and fruits in pottery from graves and settlements.

Since the burial pottery vessels had been manufactured in the settlements, the botanical material trapped in their fabric represents the use of plants in the same settlements.

Swedish grave finds of cultivated cereal remains are recorded according to place, species and date (table 2). Where individual grains/seeds have been found in archaeological excavations of graves, these carbonized cereal or other plant residues have been observed with the naked eye during the excavation of the burial deposit without recourse to archaeobotanical investigation methods. It is unlikely, however, that only a few cereal grains were laid down as grave gifts, but rather a container full of cereals, often a pottery vessel, would have been placed there (Robinson & Siemen 1988), or else a small cloth or leather bag or sack might have been used (Ramqvist 1992:107). The different species can occur in combination or alone (Viklund 1997). Even whole sheaves were sometimes deposited as grave gifts (Viklund 1998), to judge from findings of fragments of corn ears (Larsson 1998:110). Two cremation graves can be cited where finds of single cereal grains have been reported: a grave mound dated to the Vendel period at Spelvik in the province of Södermanland, species unidentified (Lamm 1962), and cremation grave Bj 208 at the Viking period Birka site on the island of Björkö in Lake Mälaren, which produced a grain of wheat (Arbman 1940:83).

Among Hjelmqvist's many analyses of seeds there were cereals (not imprints) in four graves located in different provinces and representing different periods in time. At the excavation of the westernmost of the three huge mounds at Old Uppsala, called the Kings' mounds in the local tradition (Sw. *Västhögen*), grains of barley were found among the grave gifts (Sarauw 1899), four of which are now lodged with the Museum of National Antiquities in Stockholm (Lindquist 1936:201). Two of these cereal grains have been identified more closely (Hjelmqvist 1960). Barley has been found in two graves in the province of Jämtland, a Vendel period grave in Månsta in the parish of Näs, in which as many as 75 grains of barley and some fragments had been placed, and one Viking Age grave at Hof in the parish of Frösö, where 7 grains of barley were found (Hjelmqvist 1960:148). In a Viking Age burial at Barshalder in the parish of Grötlingbo on the island of Gotland, a larger urn containing fruits and seeds was found, with two grape seeds (*Vitis vinifera*) and three apple pips (*Malus sylvestris*) in addition to cereals (Hjelmqvist 1993:275, 1996:164-165). At another Viking Age burial site at Barshalder, a metal vessel (copper) in the female inhumation grave contained barley grains and peas (Trotzig 1991:217; Isaksson 1996:46).

Systematic searches for cereals and other plants have been made recently in soil from graves, using archaeobotanical methods and in particular analyses of fossil plant remains.

Analyses of fossil plant remains have been undertaken within the framework of Malmö Museer in order to study the ancient cultural landscape and agricultural development and change from the Late Neolithic to the Late Iron Age at Fosie IV in the province of Scania, southern Sweden. Cereals were found in two of the graves, about 7 grains in grave 4000, dated to the Early Bronze Age, and 8 hulled barley grains and fragments of about 11 other cereals in grave 3053, roughly dated to the Late Bronze Age – Roman Iron Age (Gustafsson 1995).

Table 2. Carbonized cereal microfossils found in Swedish prehistoric graves.

Locality Province / Parish / Site	Structure	Grave type	Date	Human osteol. evidence	Barley	Bread wheat	Emmer/ spelt wheat	Wheat	Avena	Cerealia indet.	Other plants	Reference
Scania / Malmö / Fosie IV	4000	stone setting, rectangular	Early Bronze Age	child	3					c. 7	-	Gustafsson 1995
Halland / Årstad / Sannarp 1:1	Raä 3, A86a	mound	cal <sup>14</sup> C 1740–1500BC	adult, possibly older person					2	3	-	Larsson 1998x
Halland / Årstad / Sannarp 1:1	Raä 3, A80:a	mound, oval	cal <sup>14</sup> C 1257–906BC	14–17 years old, male	2		6	1	1	13	+	Larsson 1998
Scania / Malmö / Fosie IV	3053	cremation burial	Late Bronze Age – Roman Iron Age	+	8					c. 11	+	Gustafsson 1995
Uppland / Odensala / Odensala vicarage	Raä 235, A8	central stone setting, burial enclosure	Early Iron Age	-	59	1	c. 13	6		c. 55	+	Hansson 1994
Uppland / Odensala / Odensala vicarage	Raä 235, A35	stone setting, burial enclosure	Late Neolithic – Early Iron Age	adult						1	+	Hansson 1994
Uppland / Vendel / Vendel	Raä 28, A3	stone setting, triangular	Migration Period	+	1						+	Bergström 1998
Uppland / Vendel / Vendel	Raä 28, A1	mound, almost round	5th century?	+	1					2	-	Bergström 1998
Uppland / Vendel / Vendel	Raä 216, A3	mound, almost round	5th century	+	2						+	Bergström 1998
Uppland / Vendel / Vendel	Raä 8, A2:2	cairn	5th century	+	1					c. 10	+	Hansson 2001
Uppland / Old Uppsala / Old Uppsala	Västhögen, SHM 5308	mound	c. 550 AD	adult	4						-	Sarauw 1899, Lindqvist 1936, Hjelmqvist 1960
Uppland / Vendel / Vendel	Raä 26, A2	stone setting	Early Vendel Period	+	127	17	3?			104	-	Hansson 1997
Södermanland / Spelvik / Trossbacken, Landshammar	A/1944	mound	Vendel Period	+						1	-	Lamm 1962

Locality Province / Parish / Site	Structure	Grave type	Date	Human osteol.		Botanical content					Reference	
				evidence		Barley	Bread wheat	Emmer/ spelt wheat	Wheat	Avena		Cerealia indet.
Jämtland / Näs / Månsta	SHM 14202:1	mound	Vendel Period			75					some fragments	Hjelmqvist 1960
Uppland / Vendel / Vendel	Raä 8, A1:1	cairn	7th century	+		1				c. 3		Hansson 2001
Uppland / Husby Långhundra/Gullhögen	Raä 30	mound	Viking Age (?)	+		63		14	3	1	101	Hansson 1995a
Uppland / Adelsö / Björkö	BJ 208	mound	Viking Age	+					1			Arbman 1940–43, Gräslund 1980
Uppland / Vendel / Vendel	Raä 8, A1:2	mound	8th century	+		3	1				4½	Hansson 2001
Gotland / Grötlingbo / Barshalder	SHM 32181:9s	shaft	Viking Age		male	70	2*					Hjelmqvist 1993, Thunmark-Nylén 1995
Gotland / Grötlingbo / Barshalder	SHM 27778:13:1	shaft	Viking Age		female	several						Trorzig 1991, Thunmark-Nylén 1995, Isaksson 1996
Södermanland / Sorunda / Fällnäs	Raä 518, A2	mound	Viking Age		1 child and 1 adult	3	1				1	Ullvin Andersson 2002
Södermanland / Sorunda / Fällnäs	Raä 518, A5	mound	Viking Age		1 child and 1 adult	1						Ullvin Andersson 2002
Uppland / Vendel / Vendel	Vendel 1:1, F134	shaft	Viking Age		female	4					c. 9	Pelve 1995
Jämtland / Frösö / Hof	SHM 13804:2	mound	c. 900 AD.		female?	7						Hjelmqvist 1960

\* *compactum* type

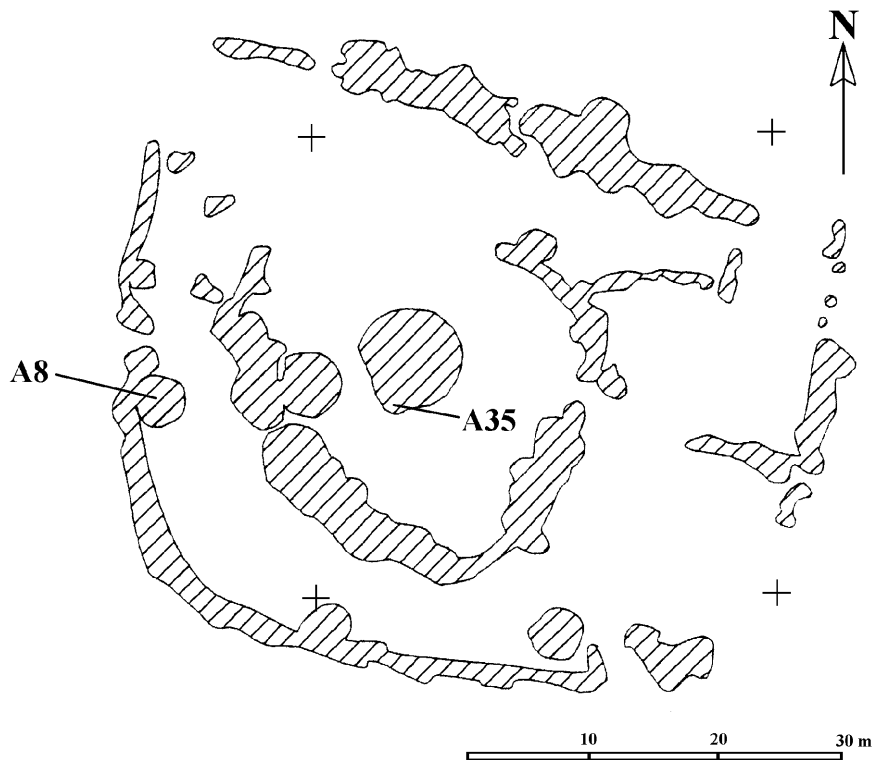


Figure 5. Map of the younger Bronze Age – older Iron Age enclosure with double walls in the prehistoric hill fort at Odensala vicarage in Uppland. The two stone settings with cereal finds (A8 and A35) are shown. After Olausson 1995, modified by Liselotte Bergström.

In 1988–1992, the great mound of Gullhögen, Husby Långhundra parish, Uppland, was excavated by ARL under the direction of Professor Birgit Arrhenius. Samples were collected for plant macrofossil analysis. The stratigraphical record was very complicated and it is uncertain whether there were two or three burials inside the mound. Of the two clear burials, one is dated to the Roman Iron Age, AD c. 300, and the other to the Viking Age. The identified remains of cereals as well as edible nuts and berries included shells of hazelnut (*Corylus avellana*), wild strawberry (*Fragaria vesca*) and cowberry/bilberry (*Vaccinium* sp.). These fossil plant remains seem to connect to the Viking Age grave (Hansson 1995a).

The ARL has been conducting excavations for a number of years at Vendel in the parish of the same name in the northern part of the province of Uppland, within the scope of a research project “Svealand in the Vendel and Viking Periods – Settlement, Society and Power” (sv), undertaken jointly with the Institute of Archaeology at Uppsala University. The site features a cemetery with boat burials containing precious grave gifts, warriors’ equipment and horses, vessels and other artefacts for food and food preparation, and also food animals, birds of prey and hunting dogs. The oldest of these are from the 6th century or somewhat earlier and the youngest from the end of the Viking

Age (Seiler 2001:52). The aristocrats in Vendel had close contact with the social elite in north-western and central Europe. The boat graves are not burned, and it is exclusively men who are buried there. Near the boat burials lie other grave fields with cremation graves, partly of more or less the same date. Here we again find highly valuable grave gifts, and the deceased include women and children as well as men. We do not know if these different burial traditions also resulted in the provision of different plant material as grave gifts, but it is important to bear this in mind when interpreting the results of the archaeobotanical analyses at Vendel.

A number of cremation burials at Vendel have been examined archaeobotanically within the framework of the sv Project. A Viking Age grave urn in Vendel 1:1 contained the remains of a cremated woman and also cereals (Pelve 1995), and six other cremation graves were analysed for fossil plant remains, three of them being found to contain cereals. Two of these graves were situated at the site Raä 28, one dated to the 6th century AD and the other to the Migration Period. In addition, one cremation grave at the site Raä 216 which has been dated to the 6th century also yielded cereals (Bergström 1998). The cremation graves at the site Raä 26 have also been investigated archaeobotanically, revealing hazelnut shells in a grave from the Migra-



tion Period and an abundance of cereals in another grave at the same site, although these were unfortunately severely damaged by the heat from the funeral pyre (Hansson 1997). Archaeobotanical analyses are at present being conducted at “Vendla’s mound”, close to the boat burials, which possesses several cremation graves, three of which were analysed for plant remains, and all three proved to contain cereals (Hansson 2001).

A cult site within a double-walled enclosure at Odensala vicarage, situated on a ridge in the parish of Odensala, province of Uppland, has been excavated (Olausson 1995) and subjected to archaeobotanical investigations (Hansson 1995b). Most interesting from our viewpoint were the contents of one of the graves in the central stone setting, dating back to the Earliest Iron Age or Late Bronze Age/ Pre-Roman Iron Age transition. This grave (A8) was situated at the entrance to the enclosure (fig. 5), which might be an indication of special symbolic value. The archaeobotanical material was extensive with regard to crop species and the rich quantities of seeds and fruits found, including seeds of the oil plants flax (*Linum usitatissimum*) and gold of pleasure (*Camelina sativa*) together with various species of cereals. A further grave associated with the enclosure (A35) also contained cereals (Hansson 1995a:218f; Olausson 1995:263).

Within the scope of the research project “Strongholds and fortifications in Middle Sweden 400–1100 AD”, led by researchers at the ARL, which started in the year 2000, excavations have taken place at Fällnäs in the parish of Sorunda in the southernmost part of the province of Södermanland. Here two Viking Age graves contained cereals: 3 grains of barley (*Hordeum* sp.), 1 of bread wheat (*Triticum aestivum*) and 1 unidentified Cerealia grain were found in grave 2 and 1 hulled barley grain (*Hordeum vulgare*) in grave 5. The analyses of fossil plant material in soil samples from graves at the Viking Age Fällnäs site formed part of a degree dissertation (Ullvin Andersson 2002).

Other graves in various localities in Sweden have recently been investigated archeobotanically, but the results are as yet unpublished (Håkan Ranheden, Mats Regnell, Karin Viklund, pers.comm.).

It has proved possible to trace cereals in graves with the help of pollen analysis. For example, analysis of soil in the remnants of a pottery vessel from a late neolithic stone cist in the parish of Hamneda, province of Småland, yielded pollen of wheat (*Triticum* sp.) and barley (*Hordeum* sp.) (Lagerås 2000).

There may also be other finds of cereal grains in prehistoric burials (perhaps even some published ones), which are not recorded in table 1, although the intention has been to make this table as complete as possible so as to lay the foundation for a future database of cereal finds in Swedish prehistoric graves.

### 1b. Products

#### (bread, porridge or grain-paste, textile fibres)

It is not uncommon to find pieces of bread or other organic material such as porridge or comparable cereal-based foodstuffs in connection with archaeological excavations of Iron Age graves in Sweden (Schnittger 1912; Hagberg 1959; Gräslund 1967; Arwidsson 1984; Hjelmqvist 1984, 1990; Viklund 1993, 1994; Hansson 1994; Hansson & Isaksson 1994), and a number of these have been analysed archeobotanically (Rosendahl

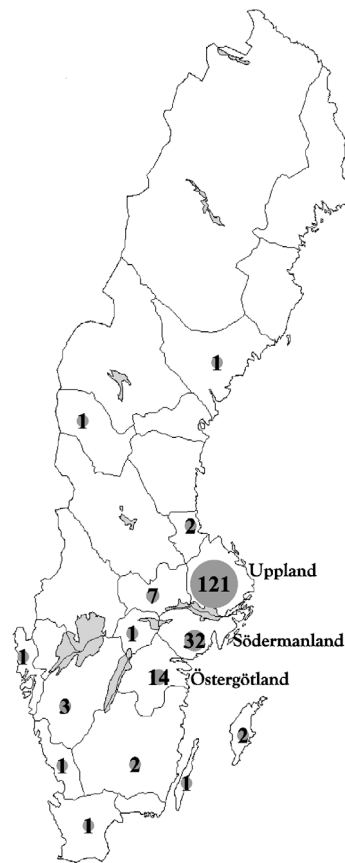


Figure 6. Numbers of carbonized bread finds in archaeological contexts in Sweden, by province. The majority of the prehistoric bread loaves and bread like organic concretions are found in the provinces of Uppland, Södermanland and Östergötland. Drawing by Liselotte Bergström.

1909, 1912a,b; Hjelmqvist 1984, 1990; Hansson 1996a, 1997, 1999; Isaksson 1999).

At the Viking Age site of Birka, the cemeteries lie beyond the settlement area, effectively surrounding it. Most of the graves were excavated at the end of the 19th century. About 500 of these represent cremations, and some contained organic material that has been identified as whole or fragmented mini-loaves of bread, or less precisely as “food residue” (Hallström 1913; Arbman 1940, 1943; Campbell 1950; Arrhenius 1978:21; Arwidsson 1984; Hjelmqvist 1984; Keyland 1989 (1919); Hansson 1996a[1997]). There are certain circumstances which make the analysis of these loaves / food residues especially interesting. Birka had international trading contacts, and the fact that the cremation graves and inhumation burials date from the same period is often discussed in the light of foreign influences on the population of the settlement. Thus it is not impossible for the ingredients used in the bread/food residue to show some influence from foreign food traditions. Furthermore, the large number of graves allows statistical treatment of the results of the archaeobotanical analyses.

Even though pieces of carbonized bread can sometimes look very similar to charcoal to the naked eye, it has proved possible to discover loaf fragments and other carbonized food residues from

among the charcoal and cremated osteological remains in the older excavation material. Experience in identification and a knowledge of exactly what to look for greatly increase the chances of success in this detective work.

If we provisionally chart the archaeological finds of attested and possible loaves of bread (fig. 6), we see a major dominance of graves in eastern central Sweden dating from the Iron Age. This chart also includes bread found in settlements, although the finds are few in number – being mainly associated with the farmstead of Helgö in the province of Uppland, dated to the Roman Iron Age, the hill fort of Boberget in the province of Östergötland, dated to c. 400–500 AD, and the Black Earth at Birka. This distribution may be distorted on account of non-systematic data collection, however, as the chart is based on published information supplemented with oral communications from archaeologists working near Stockholm. Despite the possible geographical bias, the data nevertheless clearly show that loaves of bread or porridge/grain paste played a not infrequent role as grave gifts during the Iron Age.

Another type of food remains frequently found in prehistoric graves is organic residues on ceramic sherds. These finds contain important information, and the resulting analyses may be able to contribute substantially to palaeonutritional research. One example that may be mentioned is that of the food crusts found in a grave dated to the 8th century AD at Vendel 8, “Vendla’s mound” (Isaksson 2000, VII:6).

Flax has survived in graves in the form of carbonized seeds and of textile fibres in the deceased’s clothing. Textile fibres occurred in boat grave no. 5, from the Vendel period, at Valsgärde, about 10 km north of Uppsala (Malmius 1998:73), and in boat grave no. 1, from the Viking Age (Malmius 2001:92), and boat grave no. 36, a Viking Age female inhumation burial, at Old Uppsala (Malmius 2001:83). In addition, boat grave XII at Vendel contained fabric woven from flax yarn (Malmius pers. comm.). In the Viking Age town of Birka on Lake Mälaren, flax textiles have been found in graves Bj465A and Bj619 (Geijer 1938:180; Hägg 1986:51). Fragments of such textiles have also been found in the boat grave at Augerum in the province of Blekinge and have been dated to the transition between the Migration and Vendel periods, so that they must be older than those in the famous boat graves at Vendel and Valsgärde mentioned above (Arrhenius 1960:172).

## 2. Wild plants

Wild plants have been collected and used as food, as utility goods and for other purposes or reasons in burial rituals, even though the evidence for these uses is sparse when it comes to prehistoric graves.

### 2a. Raw material

#### i. Edible plants (roots, berries, fruits and nuts)

The indications are that people at all times have maintained an excellent knowledge of the wild flora and of the uses to which plants can be put (Hansson 1997a:60), and therefore it would also be natural for collected wild plants to figure as prehistoric grave gifts. Evidence for the collecting of edible plants is available in the form of archaeobotanical remains in human latrine

waste and waterlogged settlement layers from early medieval times onwards. A Viking Age offshore sediment layer at Birka, for example, contained latrine waste with a vegetal content (Risberg et al. 2001). Most often these remains consist of berries, e.g. wild strawberries (*Fragaria vesca*), bilberries (*Vaccinium myrtillus*), lingonberries (*Vaccinium vitis-idaea*) and pips of crab apples (*Malus sylvestris*). Thus eating collected plants was a part of the prehistoric dietary pattern.

Written records referring to older dietary customs in Scandinavia can also be employed with caution to obtain more information on the possible use of plants as food in prehistoric times (see Hammarstedt 1905; Rosén 1949). While the gathering and use of some of these plants may be a late custom, certain plants could belong to a dietary pattern bound by ancient tradition.

In one of the inhumation graves at Birka, chamber grave Bj1037, a fruit stone of the bullace (*Prunus domestica* ssp. *insititia*) was found in the remains of a leather bag. Plant materials can often survive thanks to the immediate proximity of metal objects, so that leaking metal salts preserve the organic material. Kernels of sloes (*Prunus spinosa*) were found in graves Bj29 Bj39B, Bj80C, Bj770 and Bj1037, and also in the settlement area known as the Black Earth (Hansson 1997), while grave Bj770 yielded a kernel of hawthorn (*Crataegus calycina*). Hazelnut shells (*Corylus avellana*) are the most common plant remains, being found in graves Bj13, Bj45, Bj54B, Bj65, Bj66, Bj135, Bj181, Bj196, Bj215, Bj343, Bj418, Bj449, Bj465, Bj503, Bj637, Bj763, Bj913, Bj1010 and Bj 1045 (Arwidsson 1984), and also in the Black Earth (Hansson 1997a), in a house near the rampart at Birka (Hansson 1993) and in one of the female cremation graves at Vendel (Hansson 1997b).

Root tubers of dropwort (*Filipendula vulgaris*) and stem tubers of oatgrass (*Arrhenaterum elatius* ssp. *bulbosum*) have sometimes been found in graves, e.g. at Linköping in the province of Östergötland (Hjelmqvist 1955:121 ff; Engelmark 1984) and in Vendla’s mound in the province of Uppland (Hansson 2001). Stem tubers of oatgrass are also known from graves of the Migration/Viking Period at Sannagården in the parish of Vinberg, province of Halland (Viklund 1996:105), and root tubers of dropwort from Late Iron Age graves at Lovö in the province of Uppland (Petré 1984:66).

#### ii. Plants for other purposes

The depositing of flowers for decorative purposes is indicated by pollen analysis in the case of a Late Neolithic cist at Hamneda, Småland, mentioned above, the evidence being interpreted as indicating the presence of bouquets of wood anemones (cf. *Anemone nemorosa*) (Lagerås 2000).

Seeds of the cattail (*Typha latifolia*) have been found in a chamber grave at Birka and in boat graves at Vendel and Valsgärde. These were observed by Anita Malmius during analyses at the ARL as being attached to textile remains – probably from the fillings of cushions or quilts (Malmius, pers. comm.).

### 2b. Products (wood in coffins, tar sealings, birch-bark containers)

Collected plants have of course played a part in the making of bread and other edible products. The most common botanical

find in cremation graves, charcoal from funeral pyres, will not be considered here, however, although its analysis can give information on the tree species present in the surrounding area and on which species were chosen for fuel. Wood was also put to other uses, including the construction of coffins or burial chambers (Gräslund 1980), and the building of the boats used for burial purposes. Among the most famous Swedish cemeteries with boat burials are those at Vendel (Stolpe & Arne 1912), Valsgärde (Arwidsson 1980) and Old Uppsala (Nordahl 2001) in east central Sweden. Often the wooden part of the boat has rotted away, leaving only the rivets with little or no traces of wood adhering to them. The Årby boat, found near Uppsala, is one of the few that have been preserved from the Viking Age in Sweden (now in the Museum of National Antiquities, Stockholm). It was clinker-built with two rows of planks, the upper of Scots pine (*Pinus silvestris*) and the lower of oak (*Quercus robur*), as was the frame, while the dowels were made of juniper (*Juniperus communis*) (Arbman 1993:28f). Other wooden objects were preserved in this boat. Another boat was preserved in Viking Age grave 75 at Tuna in the parish of Badelunda, Uppland, in the same way as the Årby boat, due to the surrounding clay (Schönback 1994:44ff), and cereals, bread and other necessities of smaller dimensions could no doubt also have been found here if the right methods for dealing with this type of material had been available at the time, cf. the Oseberg ship excavation (Holmboe 1927).

Archaeobotanical grave material includes objects made of wood or wood products. In Sweden these can include the tar sealings, mostly made from birch-bark, that are found especially in Iron Age burials (e.g. Svanberg 1996). Other products made of birch-bark tar to have been discovered in graves include the tar loaf found in a Bronze Age oak coffin burial in the parish of Alva on the island of Gotland (Floderus 1931:110), the tar decorations used for inlays and appendages on grave gifts, as identified on a bronze sword from Bronze Age stone cairn no. 7 at Bästekille in the parish of Södra Mellby, province of Scania (Oldeberg 1974: 119–120, 1976:10). Finds of tar and pitch have also been reported at settlements (e.g. Sandelin 1998; Bergström 2002) and in sacrificial deposits in bogs.

Because of its inherent preservative qualities, birch-bark is one of the main uncarbonized plant materials to survive in Swedish inhumation graves, e.g. in some of the boat graves at Vendel and Valsgärde (Stolpe & Arne 1912; Arwidsson 1942:106ff, 1954:85ff, 107ff). A chamber grave at Birka yielded remains of a plaited birch-bark artefact interpreted as a feeding bag for horses (Fennö Myyung 2000:9), and birch-bark vessels, remnants of what appear to be wooden dishes and traces of other wooden artefacts have also been found in the Migration period chamber grave, mound 2, at Högom in the province of Medelpad (Ramqvist 1992).

## Discussion

We have presented here various methods which we use to extract and identify plant material from graves. The overall aim of our work is to extract as much botanical grave material as possible and to compare this with corresponding material from settle-

ments in order to identify contextual differences. One vital source-critical aspect, however, is the possibility of contamination. The place chosen for the burial site could have been used previously as a settlement site, or indeed as an earlier burial ground, so that the earth used to fill the grave in might contain residue from an earlier period. The composition of the plant material can act as an indicator of this.

The archeobotanical material found in Swedish prehistoric graves so far clearly shows that plant material served a wide range of purposes in relation to burials. These finds contain invaluable information for interpreting general burial rituals and the symbolic use of plants, and they can also cast new light on certain aspects of the society of the living. The distinction between cremation and inhumation burials, in terms of grave morphology, structure and content (including grave gifts of botanical origin), mirrors structural changes in the living society, and this must be considered when interpreting burial rituals. It is during periods of fundamental change in society, with profound shifts in ideology and new establishment phases, that burial rituals assert themselves (Hedeager 1999:65).

The plants found in graves were deposited there deliberately, in contrast to those associated with settlements, although both provide an overall view of plant use and cultivation. A proper understanding of the plant evidence must include the reconciling of factors such as the positions within the grave where the different types of plant were found, the grave type, the age and sex of the deceased, and also the geographical location of the grave and of course its date. This information can then lead to formulations regarding the functions of the different plants during the burial process, what they symbolized and how they were used ritually.

## Function

The Egyptian pyramids were among the very first graves in which botanical material was documented (Heer 1866:46; Laurent-Täckholm 1951). The concept of life after death as represented in these shows a strong materialistic belief, so that the deceased was provided with a full set of equipment in the grave deposits. Plant material, both collected and cultivated, was represented here in all its forms, as food – both raw, i.e. cereals, and prepared, i.e. products such as bread and beer (Samuel 1994, 1997, 2000) – and as decorations, in the form of wreaths etc.

It is similarly possible to study the intended function of the grave gifts in the Swedish material. No prehistoric grave has survived in Sweden with all the material intact, and as a result the organic remains that do survive are all the more significant for the assessment of their function. We must keep in mind the possibility that the plant material may also have borne a deeper significance than meets the eye. The choice of cereals may have been governed by which types were used for sowing, for brewing beer or malt products, or for cooking. When we find oats, for example, we cannot exclude the possibility that these may have been intended as “fodder” for the dead horses accompanying the deceased into the grave (see also Sundqvist 2001:38). The grave gifts in the form of food may have been deposited with the idea that the dead person really would continue his life within the grave as well as playing an important role during one phase of

the transition or during the journey to the kingdom of the dead (Kaliff 1997:101).

Artelius draws attention to the stem tubers of oatgrass found in certain Viking Age graves, which he considers be representative of two separate concepts. The stem tubers may partly have had an ancestral function in relation to the (lifegiving) cultivated crops and they may partly have been deposited as representatives of “wild” nature, providing a link with the universe outside the world ruled by humans, where plants acted as hosts for spirits which had to be appeased, a world where creation was re-transformed through rituals (Artelius 1999:226, 2000:186).

Wood had many functions in graves, as already mentioned. The boats found in graves, for example, once served as means of transport and now have undergone a metamorphosis to serve as symbolic burial chambers, ingredients in religious rites (Lidén et al. 2001:31).

It is by no means far-fetched to consider that flowers were laid out in graves even in Scandinavia during prehistoric times both as tokens of grief, in the form of bouquets or single flowers [as in the early Bronze Age oak coffin burial of a female in the parish of Egtved in the county of Vejle, Denmark (Brøndstedt 1966:73)], and also as a filling for the bolsters on which the dead were laid [as in the three Bronze Age cist burials at Ashgrove, Fife, eastern Scotland (Tipping 1994:138)]. It is also conceivable that strong-smelling plants were strewn around to disguise unwanted death odours.

### *Symbol*

The great importance of cereals in Mediterranean lands is well known. Ears of corn were included as decorations on coins in Metapontum in southern Italy around 500 BC (Heer 1866) as symbols of power and prosperity, while in other contexts they symbolized fertility and resurrection. Cereals (especially wheat) and other crops had their own goddess, known in Carthage as Tanit (Währen 1980), also Tinith, Tinnit, a name that first emerged, to the best of our knowledge, during the 5th century BC (Hurst 1999), in classical Greek areas as Demeter, and in the Roman Empire as Ceres. Her image appears on coins, where she carries one or more ears of corn in her hair. In Scandinavia we have the goddess Freja, who to some degree corresponds to these Mediterranean concepts. According to Artelius, the sacrifices of plants made during the Scandinavian Viking Age might also be considered to have represented fertility and beliefs about human regeneration (Artelius 1999:224). Not dissimilar ideas are to be found within Christian ideology, where the grain of wheat must first “die” in the ground in order to come back to life and bear fruit (cf. John 12:24, 1 Cor. 15:36 ff.) (Dahlby 1963:116) (fig. 7). An ear of corn can still be found as an emblem on modern gravestones (fig. 8). Is it possible that we, in our modern and often secularized world, still observe the same symbolism?

In the Mediterranean area during Classical Antiquity, cereals were seen as symbolizing life, while leguminous plants, especially beans, sometimes symbolized death (Binde 1999:214f). In China we find a highly advanced symbolic system for plants, and it is reasonable to ask whether an equally rich system existed in Scandinavia during prehistoric times. We know that the cer-



Figure 7. The wheat grain must first “die” in the ground in order to rise to life later and bear fruit. Drawing by Dahlby 1963:116.



Figure 8. Ears of wheat on a modern gravestone, old city cemetery, Uppsala. Photo by Erik Hansson.

eals had different symbolic worth, and that wheat was considered the “finest”, being mentioned in connection with the meal of a nobleman in a reference in the Poetic Edda that is usually considered to describe conditions in the Viking period (Collinder 1964). Even decorative material may have had a symbolic value as well. Thus the grave of the great man Kent, of the 20th dynasty – 1200 BC, in Thebe, Egypt, included a beautiful necklace made of celery leaves, where celery served as a symbol of death (Laurent-Täckholm 1951:110f).

The prehistoric loaves of bread found in graves in Sweden show various morphological differences which might be of symbolic significance. Some of them were threaded on a small piece of iron wire for hanging up, thus gaining a circular form, also considered a holy symbol in some contexts in the Mediterranean area, where bread is known to have been kneaded into a long roll and the ends pressed together (Berg 1963). The early Christians used shapes like this for their Eucharistic bread. This is a further example of how Christianity adopted and expanded the rich system of symbols that was already in existence. In particular, bread made from the finest wheat still plays a central role in the sharing of the Eucharist, the very foundation of Christian worship (Hansson 1997a).

### *Rituals*

There is a close connection between cults of death and fertility, and the two would often be integrated. Such religious concepts have their basis in the cyclic process of death and resurrection. There is also a close connection between cultivation and fertility, which also generates rituals when dealing with the dead (Kaliff 1997:76).

The placing of gifts in graves often assigns ritual significance to non-organic material, e.g. the incidence of pottery vessels being placed in a similar fashion during the Roman Iron Age

(Ejstrud & Jensen 2000). Thus the placement of grave bread seems to follow a ritual pattern. In the cremation graves at Birka, the bread is often found in a burial urn or in such close proximity to such an urn that it can be presumed to have originally been deposited in it.

Just as one burial ritual may have required the use of a specific sort of cereal, another may have given priority to diversity. Likewise, burial bread may have had deliberately chosen ingredients on particular occasions. Viklund especially draws attention to this multiplicity. In rituals where plants play a part, in prehistoric times as well as later, multiplicity is of great importance (Viklund 1997).

The occurrence of food residues on grave ceramics may represent two modes of deposition, residues from earlier secular use of the same vessels and residues from a “ritual” meal which accompanied the dead into the grave. Examples of the first mode of deposition include a Viking Age burial urn found at Vendel 1:1, where chemical analysis shows that it had been used previously as a food container (Donkow 1995:35), and the Pre-Roman Iron Age grave urn found at Kyrkbacken in the parish of Horn, province of Västergötland, which had a sticky, carbonized mass containing einkorn and emmer wheat at the bottom, beneath the bone fragments (Hjelmqvist 1999, Pedersen & Widgren 1998:397). Since great care was taken over burial rituals, Kaliff believes that the ceramic vessels with organic residues adhering to the inside were most likely chosen consciously to represent everyday ware, and perhaps also as items that had been well used. This may have been a way of linking the earthly remains of the dead with the farm and with the ground (Kaliff 1997:101).

The occurrence of food residues which functioned as grave gifts in the grave ceramics is more difficult to prove. Chemical analyses performed on ceramics from both settlements and graves show a significantly larger proportion of biomarkers of animal characters in the grave ceramics than in those from the settlements (Isaksson 2000 paper VII:24), which could indicate that certain products were preferred as grave gifts. This is of course also valid for the choice of plant food.

### Future analysis

Our aim is to bring grave gifts of botanical origin to light and to learn how to interpret them.

We now know from recent analyses of plant material that innovative approaches are possible through the use of new laboratory techniques trimmed for specific types of material, thereby capturing evidence even where very poor preservation conditions existed. Such evidence has previously been beyond reach, as it has remained outside the scope of traditional archaeological excavation techniques.

This now means that graves excavated by traditional methods have not yielded all the traces of the grave gifts originally deposited in them, and that some new traces might still be discerned. We thus wish to emphasize the importance of archaeobotanical material – wild plants, cultivated plants, cereals and bread – so that it will be possible to use this in combination with inorganic material to achieve a more complete view of the contents of graves and thus also of burial rituals.

The analysis of plant material and its placement in graves can also provide unique evidence for the use of the same material in settlements, as fodder or food, and even of methods of bread preparation. It is possible to ascertain whether the ingredients in grave bread change with time and with changes in grave rites and grave types, when yeast or sour dough emerges, how the bread was baked – over a stone, in an oven or in the ashes of an open fire, whether cereals were hulled before being deposited in the grave, or whether they were laid there in sheaves.

A wide variety of information can obviously be gleaned from studying how plant material functioned within burial rituals. Our aim for the future is to obtain such knowledge from the samples that we have gathered, so that we will be able to contribute to a deeper understanding of how prehistoric botanical grave gifts acted – *ritually, symbolically and functionally*.

### Abbreviations

ARL	Archaeological Research Laboratory at the University of Stockholm
FTIR	Fourier transform infrared spectrometry
GC/MS	Gas chromatography-mass spectrometry
HF	Hydrofluoric acid
IR	Infrared
KVHAA	Kungl. Vitterhets Historie och Antikvitets Akademien (The Royal Academy of Letters, History and Antiquities)
RAÄ	Riksantikvarieämbetet (Swedish Central Board of National Antiquities)
SHM	Statens historiska museum (National Heritage Board of Sweden)

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