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Food Remains from the Gut of the Huldremose Bog Body

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INTRODUCTION

The Huldremose body was recovered from a peat bog at Ramten, Djursland, Denmark in 1879. Although it has never been subject to conservation methods, over the years it has gradually dried out and apparently stabilised. An initial radiocarbon date of 1920±100 bp (K-1396, uncalibrated) based on samples of textile associated with the body was in good agreement with a more recent one from body tissue (1910±110 bp uncalibrated, OxA 2826). However, there are evidently problems associated with the pre-treatment of the samples for dating purposes and an earlier date in the pre-Roman period, as suggested by the textile technology, remains a possibility (Brothwell, Liversage & Gottlieb 1990).

Detailed studies of the body have been made by Liversage (1982), and Brothwell, Liversage and Gottlieb (1990) who reported a number of interesting observations. Despite the lacerations to her legs, amputation of one of her arms and injuries to her hands at, or close to, the time of death, the condition of the body is remarkable. The abdomen and chest had not collapsed onto the vertebral column as in many of the other bog bodies, and there was therefore a strong possibility that areas of gut had also remained intact. In view of this, arrangements were made for the body to undergo a C.T. (Computed Tomography) scan. With the aid of this equipment it was possible to identify accurately the position of the remaining gut material in the body which showed up as a dense area in the lower abdomen. In consultation with the conservation department at the Nationalmuseet, Copenhagen, it was decided that it would be possible to sample the dense area with minimal damage to the body and approximately two grams of material were later extracted for analysis. A detailed report of the location and extraction of the samples is presented in more detail by Brothwell *et al.* (1990).

THE ANALYSIS OF THE FOOD DEBRIS

Two samples of food debris from the gut, weighing 0.35 and 0.95 grams, were taken for analysis. The desiccated samples were then rehydrated using an 0.5% aqueous solution of trisodium phosphate. This method is routinely used in the analysis of desiccated human coprolites (see, for example, Callen & Cameron 1960 and Holden 1990; 1994). The resultant wet organic material was then sieved and all identifiable remains in the greater than 0.5 mm fraction separated for analysis and quantification. The remaining fraction of less than 0.5 mm was scanned in detail and any identifiable elements not encountered in the larger fraction removed. Four main categories of material were removed:

a) *Cereal debris* - This consisted of cereal bran (i.e. testa and fragments of pericarp). Where the pericarp had survived in a reasonable condition clearly defined thickenings could be observed in the end cell walls of transverse cell layer. These thickenings are indicative of rye (*Secale cereale* - see Fig. 1 and Winton & Winton 1932; Dickson 1987). Preservation of the bran was, however, such that the

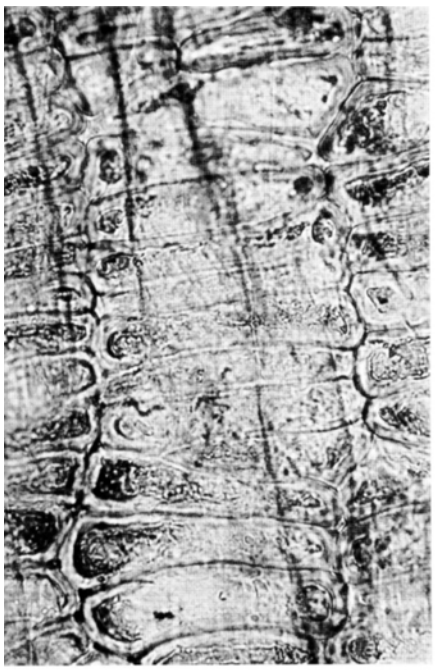
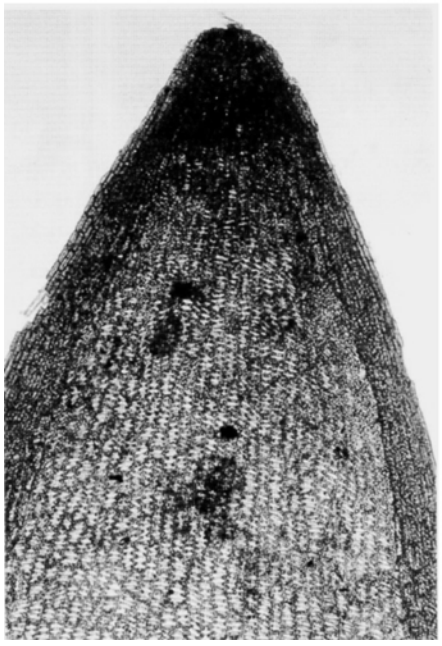


Fig. 1. The transverse cell layer of the pericarp of rye x 325.

fig. 2. The cell patterns of the testa of corn spurrey x 325.



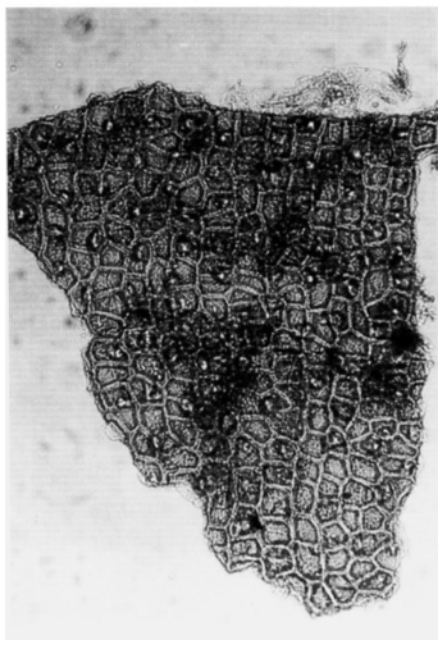


Fig. 3. One of the capsule teeth of the corn spurrey x 50.

Fig. 4. The testa of *Camelina* cf. *sativa* (gold of pleasure) x 85.

distinctive cells of the pericarp did not always survive and in these cases they could not be distinguished from wheat (*Triticum* sp.) which is anatomically very similar.

b) *Weed seed component* (used here to include items which are strictly speaking fruits as well as seeds) - This was overwhelmingly dominated by the testa fragments of corn spurrey (*Spergula arvensis*) although other species were also present (Table 1). These were identified on the basis of their gross

Species	English name	Plant part	Sample 1 **0.35 g**	**Sample 2** 0.95 g
Camelina sativa (L.)Crantz	gold of pleasure	testa fragment	+	
		siliqua fragment	+	
Spergula arvensis L.	corn spurrey	testa fragment	++++	++++
		seed without testa	+++(26)	+++(68)
		calyx teeth	+++	+++
		capsule base	++	++
		stem/axil	++++	++++
Polygonum cf. lapathifolium	pale persicaria	nutlet	+(2)	
		nutlet fragments	+	++
Fagus sp.	beech	wood fragment	+	
Dicotyledonindet.		leaf fragments	+	+
Secale cereale L.	rye	testa fragments	++	++
Setaria viridis (L.) Beauv.	green bristle grass	floret	+(1)	
Triticum/Secale	wheat/rye	testa fragments	++++	++++
Gramineaeindet.	indeterminate grass	light "chaff"	++	++
Indeterminate		testa fragments	+	
Charcoal fragments			++	++
cf. Animal connective tissue			+	+
Animal hair				+
Mineral fragments			+	+
Key + = rare, ++ = occasional, +++ = common, ++++ = abundant				

Table 1. The composition of the gut samples from the Huldremose Woman

morphology and cellular characteristics. (see Figs. 2 - 3).

c) *Other plant tissues* - This comprised a mixture of dicotyledon stem and capsule fragments (Fig. 3) that matched well with comparative examples of modern corn spurrey. Other fragments of vegetative plant tissue including a small piece of beech wood were also present in much lesser quantities.

d) *Animal and mineral elements* - Trace amounts of animal connective tissue and mineral material were also recovered.

Quantification of the debris

The quantities and state of preservation of most of the debris was such that a four point subjective esti-

mate was considered to be the best method of representing the results. This is presented in Table 1. The fragment size, and the abundance of both the cereal bran (primarily testa) and the corn spurrey seeds from these two samples were, however, such that they could be further quantified on the basis of their dry weights. To this end the greater than 0.5 mm fragments of cereal bran (which for the purposes of quantification was assumed to be rye bran) and corn spurrey seeds which had been consistently picked from the samples were dried, weighed and an attempt made at crudely calculating the equivalent dry weight of undigested food (e.g. Holden 1994).

Values given for the percentage by weight of vegetable fibre in rye grain (i.e. the undigestible part), taken from four different dietary studies (Winton & Winton 1932: 260), give an average value of 1.99%. For the purposes of this project, however, this value is probably too high. It is a notable feature of cereal bran that the outer layers of the pericarp (the longitudinal and transverse cell layers) degrade significantly on passing through the human gut. Few examples of the longitudinal cell layer remain attached to the testa in the Huldremose sample and the transverse cell layer was often considerably reduced. In view of this, the percentage of dietary fibre in rye used for this project has been reduced by approximately a third, to 1.3%. This is, however, probably a conservative estimate of the loss in weight of the fibre component of the grain and this figure may need to be reduced further if more accurate data become available.

Data relating to the dietary fibre component of corn spurrey is not readily available and an estimate of the percentage by weight of the fibre component has had to be made on the basis of other similarly sized seeds. Fat hen (*Chenopodium album*) was given a value of 14.63% fibre by Spinner and Bishop (1950) and Winton & Winton (1932 citing various authors) give values for wild radish (*Raphanus raphanistrum*) – 10.13%, amaranth (*Amaranthus retroflexus*) – 10.92% and various cabbage/mustard species (*Brassica* sp.) between 6.42% and 14.74%. The seeds of fat hen have, however, thick seed coats relative to those of corn spurrey and a value closer to most of the other, similarly sized seeds with thinner testas of 11% would therefore seem to be more suitable. These amended percentage fibre values for rye grain and corn spurrey seed have been used as the basis for conversion factors to give a more reliable estimate of their relative importance in the last meal of the Huldremose woman. The calculation of equivalent weights of undigested food based upon these conversion factors is presented in Table 2.

DISCUSSION

The calculation of equivalent weights of undigested foods indicate that a mixture of approximately 3 parts rye grain (possibly with some wheat) to 1 part corn spurrey seed made up the bulk of the "last meal".

The antiquity of rye in Northern Europe has been a point for discussion for a number of years but there is now evidence for its introduction before the Roman period (Chambers 1989; Chambers & Jones 1984; Van Zeist 1981). Chambers does, however, believe that

Sample	Weight of sample sorted	Species	Weight of identified debris in grams dry weight	Fibre content (approx.)	Conversion factors ($^{100}/_{\text{fibre}}$)	Equivalent weight of undigested food	Equivalent weight of undigested food per gram of gut contents
1	0.35 g	rye	0.004 g	1.3 %	76.9	0.31 g	0.89 g
		corn spurrey	0.011 g	11 %	9.1	0.1 g	0.29 g
2	0.95 g	rye	0.013 g	1.3 %	76.9	1 g	1.05 g
		corn spurrey	0.033 g	11 %	9.1	0.3 g	0.32 g

Table 2. The conversion of the major classes of food debris into equivalent values of undigested food

rye was not of great importance in Denmark and the Low Countries until the early first millennium A.D. If this is the case, the Huldremose sample represents an early find in this area.

In addition to the seeds of corn spurrey, other parts of the plant were also present in the sample including fragments of the capsule and stem. This might imply that parts of the plants had been eaten green although the presence of so many of the black seeds indicate that the plants must have been harvested close to maturity. It would seem more likely that it was the seeds that were the main focus of attention and that the presence of other parts of the plant represent residual unwanted fragments in a poorly cleaned product.

Some ethnohistorical data is available, relating the use of corn spurrey in the past. Salisbury (1961: 246), refers to it being grown and used as human food in the Shetland Isles. From Denmark itself, Steensberg (pers. comm. citing Hansen 1921: 114 in translation) gives an example from the last century from Brejning in West Jutland. In this area the people were poor and the children only had dry bread to eat at school, "the bread was even partly made from Spergula arvensis, because rye was so sparse".

This combination exactly mirrors that represented by the food debris in the Huldremose samples. The relatively large fragments of cereal bran and seed testa suggest that this same combination was probably eaten as gruel or as coarse bread although other preparation techniques such as roasting or crushing of the grain are possible alternatives that might also produce similarly sized fragments.

The example given by Hansen above, not only shows how corn spurrey seed was used but also links it with rye. Corn spurrey is an aggressive competitor on light and lime deficient soils (Watson & Moore 1962: 118) while rye can tolerate low fertility, acidic and dry soils (Jones 1981: 108). These two species will therefore be expected to produce well on similar soils. They may have been growing together, or, possibly in close association such as first year and second year crops in a system of shifting agriculture (see below).

A few fragments of the testa and siliqua of *Camelina* cf. *sativa* (gold of pleasure – Fig. 4) have also been identified from these samples. *C. sativa* has been recovered in quantity from a number of Iron Age sites (eg. Helbæk 1954: 255; Korber-Grohne 1988: 393; van Zeist 1981: 183) and the evidence indicates that it was most likely cultivated in the past for its oil rich seeds. It is also a weed of corn, lucerne and flax fields (Clapham *et al.* 1962). Although it seems likely that these seeds were deliberately included in part of the Huldremose woman's food the small quantities recovered from the samples indicate that they were not an important part of the meal.

It is clear from the reports of Brandt (1950) and Helbæk (1950; 1958) relating to previously discovered bog corpses, and from other reports (eg. Helbæk 1954), that a number of predominantly segetal weed seeds (ie. weeds of crops) played an important part in the domestic economy of Iron Age Denmark. The combination of a cereal component and an abundant weed seed element in the Huldremose samples therefore conforms to an already recognised pattern. Helbæk (1950; 1958) reported that the Grauballe man had eaten a meal in which corn spurrey, pale persicaria/redshank (*Polygonum lapathifolium/persicaria*), black bindweed (*Polygonum convolvulus*) and fat hen together with a number of grass caryopses had made up the weed seed element. The Tollund man (Helbæk 1950), on the other hand, had eaten barley with a substantial amount of corn spurrey, pale persicaria/redshank, fat hen, gold of pleasure, flax (*Linum usitatissimum*) and field pansy (*Viola arvensis*). Finally, the Borremose corpse (Brandt 1950) had been eating corn spurrey, pale persicaria/redshank, and fat hen with the addition of sheep's sorrel (*Rumex acetosella*). No cereal element was noted in this last case. In comparison with these earlier Danish finds, the results presented in this paper are unusual in respect of the lack of diversity in the weed seeds represented. The Huldremose sample contained a substantial weed seed element; this was, however, dominated by the seeds of only one species – corn spurrey.

These seeds must represent more than mere accidental inclusions in the meals of the Grauballe, Tollund, Borremose and Huldremose people. At the very least, they must have been a tolerated component of recognised nutritive value but were, more probably, included deliberately. Steensberg (citing Hansen 1921: 114; 1941: 122 in translation) gives two examples where weed seeds (corn spurrey, common sorrel (*Rumex acetosa*) and black bindweed) were mixed with

cereal grains in order to make bread. More recently, British prisoners reported being fed on pearl barley and cakes of weed seed during the last war (Blythe 1969: 46). Thus, in respect of the Huldremose sample, it is reasonable to suggest that the mixture of rye and corn spurrey represent a deliberate attempt to stretch dwindling supplies of cereal. The literature indicates that there are three ways in which these weed seeds could possibly have been procured for consumption:

a) *Collection from field and other environments* – Helbæk (1958: 114) suggested that these would have been collected from areas of fallow or waste land. "In the poorer districts of Jutland, the land had to lie fallow for long periods, and, arable land being thus restricted, the peasants could not afford to disregard the food value of the wild plants which sprang up on otherwise unproductive land".

b) *Recovered from the waste fraction of crop processing* – Hillman (1986: 102) suggests that both the weed seed component and the cereal chaff fragments are typical elements in the composition of the "waste" fraction from crop processing. This, he comments, could have been saved from the previous year and used as a means of stretching out meagre supplies during years of scarcity in much the same way as Maurizio 1927 (cited by Hillman 1986) recorded ethnographically.

c) *Deliberate cultivation* – As Professor Axel Steensberg has pointed out, (pers. comm. citing Hansen 1939: 75) crops of corn spurrey were grown separately in Denmark even as late as the 1850s. He again translates Hansen (1959: 110) with regard to the a system of shifting agriculture in the area of Kolkær, South of Herning, that "when they had burned the heather and taken one or two crops of rye, they used to sow corn spurrey the next year."

They also grew common sorrel in this way. Unfortunately, however, it is not clear with a number of these references whether the crops were planted with the intention of it being for human or animal consumption. It is probable, however, that distinctions between what was considered to be fit for animal and human food, or what was a fallow field and what was a secondary crop, were not clear cut and must have become further blurred in times of food shortage.

Most probably, all three of these methods of procurement were important during the Iron Age. The presence of certain chaff elements such as those recovered from the Grauballe sample (i.e. even whole spikelets of wheat) would, however, tend to support Hillman's (1986) suggestions in that case. With the Huldremose Woman, however, the case is less clear. The rye/corn spurrey mixture could represent a rye crop that had been heavily infested with corn spurrey which was then consumed before being thoroughly cleaned. The absence of rye chaff and presence of vegetative parts of corn spurrey, on the other hand, imply that the two elements were collected or possibly just processed separately only to be combined during food preparation. In any event all the evidence suggests that the seeds represented deliberate inclusions in her last meal and they must therefore have had some specific significance in the story surrounding her untimely death.

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