INVESTIGATIONS CONCERNING PREPARATION 500

Part II

Wm. F. Brinton, Jr.
Woods End Laboratory

Introduction

In an earlier research report (Biodynamics #148), we presented results of analyzing samples of preparations 500 (horn manure) and 507 (valerian). It was our objective to gain an idea of the processes which go on in these preparations during production and storage, and from this to go on to the issue of evaluating quality. The results from the 507 evaluation left little question in our minds as to how one judges quality. A combination of attributes, notably high solids content and low pH, characterized the best valerian preparation. Results for preparation 500 presented a more complex or anomolous picture, for which new questions arose, pursued in the following report.

A principle is at stake concerning the rationale for this undertaking. Can we show a relationship between analytical data and quality consistent with a view of formative forces? Does a relationship exist at all? Many say no. On the assumption that the investigator as individual is superfluous to the outcome, they are certainly right.

Much of the earlier research arising out of biodynamic quarters was directed towards generalized testing approaches yielding results to be read qualitatively or pictorally to gain an idea of qualities. These included sensitive crystalization, circular chromatography, and "Steigbilder" or capillary-dynamolysis. The impression conveyed with these methods was that life-qualities had to be looked for *only* by such means. The methods were viewed as panacea for quality judgements.

However, in actual fact, these unique methods have eluded understanding as much as any other. More recent findings suggest misinterpretation arises easily (Steffen, 1981, 1983). Basic supportive research and procedural rationale are lacking in crucial areas. Despite some good correlative studies confirming usefulness of these methods, the existing uncertainty is hardly any less in my own mind than that concerning conventional methodology. Does not the potential for penetrative discovery lie more with the form of understanding brought to the data, rather than the testing method itself? Qualitative and quantitative methods each come with their own set of limitations which must be clearly anticipated.

Experimental Design

Results of the prior testing of 500 revealed that significant internal changes had taken place in the manure during its treatment phase in the earth. Chief among these are a drop in pH, increase in aeration status and

Biodynamics, issue 157, c. 1986

production of nitrate, with little evident loss of organic matter. We indicated the unusual nature of the findings, based on our experience in analyzing manures and composts.

In the first project (Biodynamics #148) we did not gather data on the composition of the initial manure used to make the 500. Therefore, it was not possible to know to what extent any of the samples had actually changed. In the following project, all manure used for 500 was tested at the outset, and then again at the completion (Fall through Spring 1984).

As location effects were expected to occur, the same manure was used in different sites for one project. Variability was expected in relation to horns used. Therefore, we examined the quality of 500 from a group of individual horns treated in an identical fashion.

The projects are as follows:

(A) Maine Trial of a Variety of Horns
(B) Horse Manure 500—Virginia
(C) Manure Type by Site Trial—ME, NY, PA
(D) Missouri 500
(E) Manure Type by Site—VA and PA

Methods

Biodynamics preparation 500 is made by treating cow manure in cow horns which are buried in the soil over winter (Steiner, 1924). Analytical techniques we have used are described in the prior report (Brinton, 1983). We characterize the horns by taking the ratio of total weight to volume (grams/cc). Thus, large thin-walled horns have low ratios, approching 1.0, while mature-horns approach a ratio of 5, i.e., they contain a great deal of substance in relation to actual volume. We have calculated the loss of organic matter and nitrogen by contrasting initial and final values while accounting for the concentration factor resulting from decomposition.*

Results

(Table 1 and Photo A): A group of variously sized horns ranging from small to large were prepared at Woods End using manure from a neighboring dairy farm. Several of the horns were considered to be questionable, possibly from bulls. As 'controls' we used three glass and three plastic vessels of varying volume. All horns were individually identified and buried side by side horizontally in the B-horizon layer which was enriched with some aged compost and topsoil. The samples were unearthed May 26, 1984 after a winter of moderate snow-fall and limited

* For those interested the relevent simplified formulae are:

$$\text{Relative Org Matter} = \frac{(OMx\ /\ OMi)}{(ASHx\ /\ ASHi)}$$

$$\text{Relative Nitrogen} = N_x(N_i(ASH_x / ASH_i)$$

where subscripts (x) and (i) refer to final and initial values, respectively, for organic matter (OM) and ash (ASH).

Table 1. BIODYNAMIC PREPARATION 500 of VARYING HORN TYPE
before and after Maine processing

Item	Moist-%	pH	OM-%	Ash-%	TKN-%	NH3-N%	NO3-N%	ORPx	C:N	CO2-C	g/cc
		a-fresh manure; b1-poor horns*; b2-artificial horns; c-good horns									
a.	84.3	7.8	85.85	14.15	3.133	2.056	0.343	-77	15.9	3.77	1.28
b1	83.63	7.98	78.11	21.89	1.890	0.180	0.010	-122	24.1	1.25	1.40
b2	83.30	7.80	77.19	22.82	1.830	0.240	0.010	-120	24.3	1.29	-
c	72.98	5.61	80.59	19.42	3.602	0.723	0.648	239	13.2	0.64	3.40

* large,bull-like horns, no rings

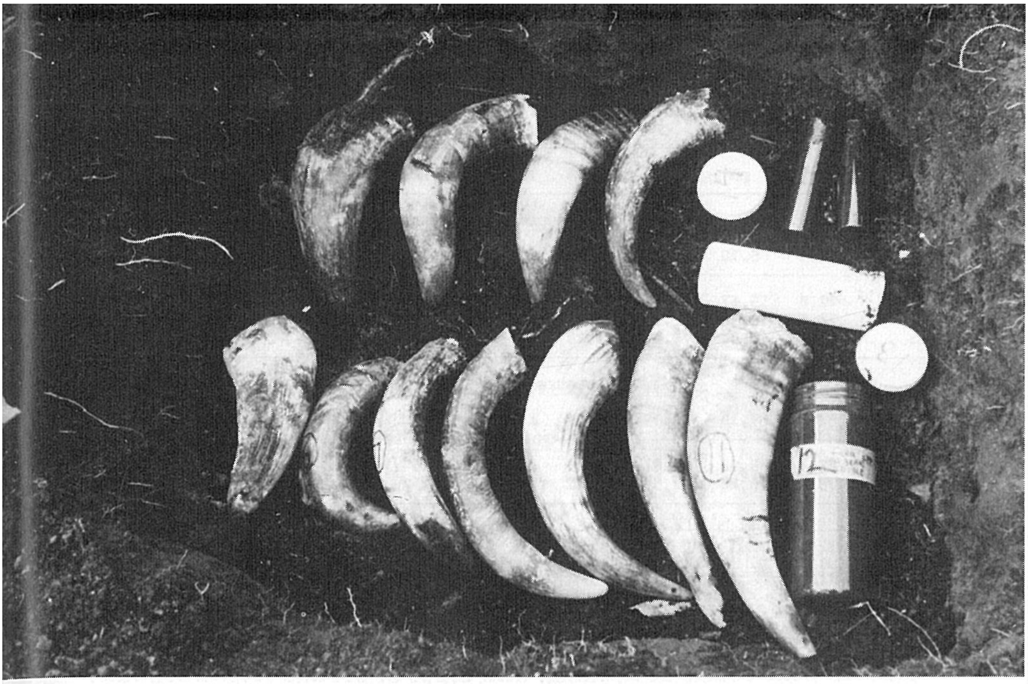
deep frost action. They were analyzed after a brief two-month storage period in a root cellar.

Analyses conducted on the contents of each horn were averaged by group, and presented in Table 1. Group (b1) refers to the questionable horns and (b2) to artificial horns, while (c) refers to the exemplary samples (subjective evaluation). The initial manure is shown in (a). We noted the horn weight to volume ratio (g/cc) where possible and present these data along with the standard tests.

Considerable variation was seen in the samples. Four horns, identified as (c) (lower left of photo) produced well ripened material, having a pleasant humusy odor and loose texture. The horns used all had high weight to volume ratios. The tests show low pH's, low CO_2-respiration and high total-N, nitrate and oxidation. In our prior study, these traits were found to be desirable.

Also interesting is that in group (b) the C:N has increased during treatment and is twice that of the better (c) group. Nitrogen loss would explain this. There is very little difference between manure kept in artificial vessels (b2), and that of (b1) horns, whereas (c) horn samples differ markedly. The artificial vessels gave the most anaerobic (ORPi) values upon being unearthed. The group (c) horn manure showed strongly aerobic values, in contrast. While group (b1-2) manure had changed very little, group (c) is unrecognizable from the initial (a) analysis.

Organic matter and nitrogen retention are shown in section 2 of Table 6. We see that on average group (b) samples have lost more organic matter in relation to group (c) and significantly more nitrogen. Group (c) has retained 84% of initial N but group (b) only 38%. Thus, in conjunction with a poor outcome of the ripening process, we find relatively large losses of organic and nitrogenous substance. There is virtually no difference between group b1 horns and those of b2 (artificial containers), further evidence that little or no action has taken place. Thus the type of container plays a major role in the preparation process. Correlations show that as the horn weight to volume aspect increases, so does the apparent ripening of



the material (Diagram 1). For example, we find the lowest pH, best appearance and highest nitrogen retention in the group of heavy horns.

(Table 2.): In Table 2 we briefly describe the results of a preparation made with horse manure, along lines indicated in Steiner's agriculture course. The material (from Virginia) appeared well ripened when dug up early fall, nearly one year after burying. The observed changes are in keeping with what we have shown for the other normal samples. Of the original organic matter, more has been decomposed (relative OM = 39%) and 52% of N has been retained which compares with regular 500 samples drawn in Spring Valley. So, it appears that the horse manure has gone through a very similar process. In the southerly climate, perhaps burying deeper, or digging up sooner, would preserve more of the original content.

Table 2. HORSE MANURE BIODYNAMIC PREPARATION 500
fresh manure (a) and after (b) processing

item	Moist-%	pH	OM-%	Ash-%	TKN-%	NH3-N%	NO3-N%	ORPx	C:N	CO2-C%
a	76.0	6.30	85.73	14.27	2.324	0.031	0.012	−34	21.4	1.35
b	68.4	4.41	70.16	29.84	2.537	0.146	0.095	+286	16.0	0.30

(Table 3.) We have considered more closely the nature of regional influences on the preparations by placing horns with two types of manure in three regions (Pennsylvania, New York and Maine). Four or five horns were used at each site, tested individually and averaged. The manure sources were varied; one (A) from Kimberton Hills farm, taken when some silage was being fed, and the other (B) from Anne Mendenhall's farm, from one brood cow on a roughage ration. There was evidently more than twice

Table 3. REGION EFFECTS ON BIODYNAMIC PREPARATION 500
Before and after processing by region

Type	Moist%	pH	OM-%	Ash-%	TKN-%	NH3-N%	NO3-N%	ORPx	C:N	CO2-C%
				(A- initial manure from Pennsylvania)						
Fresh:	84.2	6.70	88.25	11.75	2.670	0.095	0.006	-137	19.2	2.90
PA:	72.8	5.67	80.57	19.43	3.378	0.285	0.375	+250	14.0	0.28
NY:	78.6	6.78	71.28	28.72	2.827	0.179	0.490	+88	14.8	-
ME:	81.1	5.84	78.90	21.10	3.133	0.213	0.673	+290	14.6	0.26
				(B- manure from New York)						
Fresh:	82.4	7.30	94.99	5.01	1.550	0.077	0.005	-124	35.6	1.80
NY:	82.7	5.92	85.81	14.19	2.445	0.025	0.221	+130	20.4	-
ME:	79.2	5.10	87.58	12.42	3.671	0.725	0.910	+124	13.8	0.37

the ash content in (A) as in (B) and 75% more nitrogen, and the appearances were markedly different.

We were not as pleased with the final appearance of the Spring Valley samples as with the others, but all preparations appeared to follow a characteristic course of ripening, with drops of pH and respiration rate, and strong increases in oxidation status and nitrate formation. The NY samples decomposed fairly highly, showing only 33% of the original organic content (see Table 6.) and in connection with this retained only half the original nitrogen. The PA sample retained half the organic matter while preserving 92% of the nitrogen (these samples had lower pH's) while the Maine sample fell inbetween.

The second manure sample (B, brood cow) buried in NY and ME shows similar but more extensive changes. The relative OM and N for the NY site is nearly identical to the other manure (A) for that site while the Maine sample retains most the nitrogen but decomposes more of the organic matter. The general appearances of both was reasonable. Allowing that limited observations have been made, the region seems to impose its own qualities on the final product in addition to lesser influence stemming from the manure. One might want to look into the nature of the NY site, to understand why it advances the decomposition more than the others. It also showed the lower oxidation values of the entire group, indicating that ripening was slightly hindered, perhaps from moisture.

(Table 4.): Several samples were received from southern Missouri which had been prepared in different horns, some of which were from Zimbabwe. One sample turned out to be Australian 500 and another from the neighboring farm.

We were not pleased with any of the samples excepting one which showed a lower pH and more ripening, and the Australian sample which seemed exemplary of good 500 (with one of the lowest pH values recorded). All samples showed moderate anaerobisis with little or no sign of nitrate formation. We did not have a sample of the initial manure, so it is

Table 4. Missouri Preparation 500 Samples

Moist%	pH	OM-%	TKN-%	NH_3-N%	NO_3-N%	ORPx	CN	CO_2-C%
				(Zimbabwe Horns):				
85.6	7.25	77.8	2.048	.022	.011	86	22	.80
				(USA Horns):				
86.4	7.38	83.4	2.096	.022	.001	5	23.2	1.00
				(Australian prep 500):				
71.7	4.32	54.7	2.048	.011	.325	291	15.5	.10

not possible to assess any changes which may have taken place. The mean respiration rate of two Missouri samples which were checked is nearly ten-fold over that of the Australian sample, which does not surprise us. Fresh manure generally shows very high respiration rates, ripened manure not. Here, more experiments will obviously be required to assess why and to what extent this is a typical case. It is likely that the soils are exerting a major influence here, since the variation of horns and positions appears to make little difference. The one sample which did show better attributes was found to have a manure worm in it-which could explain its qualities!

(Table 5.): Another region assessed is southern Virginia at hand of two varied manure sources, one (A) from H. Courtney's cows in Virginia and the other (B) from a bred heifer of the late J. Porter's in Pennsylvania. One sample, #925, employed a hoof and not a horn container. The PA site is Stroudsburg (Josephine Porter's farm). Again, the observations are limited. The data for manure A preparation indicate generally good qualities with some apparent aeration problems at the PA site. This aspect is very noticeable with the manure (B) sample, which did not ripen at all properly at that site, and lost more organic matter and nitrogen than all the rest. We see that the pH also did not drop as expected, there is no nitrate formation, and the respiration rate is still moderately high, compared to all the rest. In the case of the hoof, all the typical changes which we have come to expect have taken place, only decomposition has been more advanced. With hoofs, there is a considerable area of exposed material, owing to the shape, but also a very favorable (high) ratio of weight to volume. So, in summary here, a site effect is apparent particularly in regarding to the PA location (it was a wet year there), but the manure source appears significant, as (A) was less deleteriously affected than (B) at the same site. Manure (A) was lower in OM, nitrogen and moisture while higher in ash content and C:N ratio. However, we have seen in another experiment (Table 3) that two manures of such different natures have performed almost equally well in favorable sites.

Table 5. Biodynamic Preparation 500
before and after treatment in PA & VA

Moist-%	pH	OM-%	TKN-%	NH_3-N%	NO_3-N%	ORPxi	CN	CO_2-C%
			(fresh manure a:)					
78.5	7.70	80.5	1.919	.129	.026	-102	24.3	1.90
			(prepared in Virginia)					
79.1	5.49	74.7	2.933	.014	.303	188	14.9	0.24
			(hoof preparation in VA)					
76.8	5.61	70.7	2.668	.032	.095	222	15.4	0.24
			(fresh manure b:)					
80.9	7.2	90.5	2.635	.513	.157	-150	19.9	2.22
			(prepared in PA)					
80.9	7.68	87.4	2.282	.043	0.001	-63	22.2	1.44

Conclusion

The foregoing study reaffirms and strengthens most of the conclusions drawn form the earlier research. Chiefly, we show that the preparation 500 process is uniquely characterized by aerobic stabilizing factors leading to self-preservation at low pH associated with a pleasant odor. However, marked differences between various horns are shown. There is some evidence presented that the greater the weight to volume aspect of the horn, the better the process outcome. Non-horn containers of similar aspect result in a material which is essentially like the fresh, unripened manure. Also, regions appear to play an important role in the outcome.

It is noteworthy that in many samples, particularly where the final appearance was pleasing, much of the nitrogen and organic matter has been retained. In some cases, N-retentions exceeding 90% are seen. Where there are other evident problems, such as internal oxidation, we see these figures drop significantly. It is unlikely that nitrogen fixation is involved, but nitrogen conservation is an interesting feature in many of the preparations tested. In some samples, however, appearance was good although N-retention was not exceptional.

In normal composting of manure, it is extremely rare that N-retentions of over 75% are found; often it is less than 30%. In fact, aerobic composting as normally practiced is found to lead to huge oxidative losses of carbon with even greater N-losses, approaching 98% in some Woods End studies. In contrast, the biodynamic preparation of manure in the form of 500 leads to a substantially different outcome. Here, decomposition appears to be

Table 6. RELATIVE ORGANIC AND NITROGEN CONTENT OF PREPARED MANURE

Group	Rel OM%	Rel N%
	(poor horns)	
	59.8	39.0
	(artificial horns)	
	49.8	32.3
	(c-good horns)	
	68.0	84.0
	Regional Samples, from Table 3: (manure type a)	
PA:	55.0	92.0
NY:	33.0	52.0
ME:	50.0	79.0
	(manure type b)	
NY:	32.0	56.0
ME:	37.0	96.0
	(Virgina samples, Table 5)	
a:	68.8	105.0
b:	73.0	65.0

arrested before proceeding as far as we see in composting. Could this be the action of life energies illicited in the peculiar preparation process, as postulated by Steiner? Or,have we simply over-looked some factor (i.e. lack of heat, soil organisms) which may explain the result? We believe that further efforts to illuminate the chemistry involved will prove extremely rewarding.

To capture our major findings:

* Horn structure,as evidence in the weight/volume aspect, is determinative of final quality. Poor horns give results nearly identical to artificial (non-horn) controls.

* Initial manure characteristics translate through to the final material, but do not exert a major influence on the apparent quality.

* Regions (site) influence the final quality in a significant but undefined fashion. It is likely that both soil-fertility and meteorology are involved. Their actions augment those operating through horn type and manure.

* Favorable preparation results are associated with less decomposition and higher nitrogen retention in the manure.

correspondence address:
Woods End Laboratory
Old Rome Road
Mt. Vernon, ME 04352

LITERATURE

Brinton, W.F. (1982) A qualitative method for assessing humus condition, in *Sustainable Food Systems,* AVI Publishers CT

(1983) Report on testing biodynamic preparations, in *Biodynamics* 148:11-24

Enqvist, M. (1977) Die Steigbildmethode, V. Klostermann Frankfurt

Fyfe, A. (196?) Moon and Plant, London

Goldstein, W. (1979) A report on previous research work done with biodynamic herbal preparations, in *Biodynamics* 129:1-11

Kolisko, E. (1979) Agriculture of Tomorrow, Steiner Press, London

Petersson, B.D. (1970) in *Nordisk forskningsring meddelande #23*

Pfeiffer, E. (1975) Sensitive crystallization Processes, Anthroposophic Press, NY

(1984) Chromatography applied to quality testing, Biodynamic Literature, Wyoming RI

Steffen, W. (1983) in *Elemente der Naturwissenschaft,* 38:1, 36-49

(1981) Botton Science Laboratory, Report #1, Report #2 Danby, Whitby, North Yorkshire GB

Steiner, R. (1925) Geisteswissenschaftliche Grundlagen zum Gedeihen der landwirtschaft, Verlag R. Steiner, Dornach Switzerland, English translation of, by George Adams, 1958, Biodynamic Literature.

Steiner, R. (1968) A Theory of Knowledge, Anthroposophic Press, NY