REPORT ON TESTING BIO-DYNAMIC PREPARATIONS 500 & 507

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Introduction

Since the time when the bio-dynamic herbal preparations were introduced (Steiner, 1924) there has been almost no attempt to characterize their composition in physical, chemical or biological terms. Pfeiffer (1941, 1948) has reported on some trace element and microbiological aspects of these preparations and more recently Stern (1976) has investigated microbiological and hormonal aspects of two of the preparations. In contrast, there has been a considerable amount of research on the effects bio-dynamic preparations have on soils, composts and plants on both a laboratory and field scale. A review, with references for several of these experiments, has recently been reported by Goldstein (1979).

In view of the potential increase in production and use of the bio-dynamic preparations in America, some independent observation of the appearance and composition of these materials may have value. Specific laboratory tests may serve in only a limited sense, considering the difficulty of interpreting test data in view of what these preparations are. To some extent, however, it may be possible to read from tests on the actual materials something about the dynamic qualities of the fermentation processes required for making the preparations.

Herein are reported the results of a project to analyze the bio-dynamic preparations 500 (horn-manure) and 507 (valerian extract) of varying origin within the U.S.

Materials and Methods

Samples: A letter of request for samples was mailed to a number of persons known to make the bio-dynamic preparations. Persons submitting samples were asked to provide information concerning the dates and methods of production. A total of 30 samples, 12 of 500 and 18 of 507, were received over a period of 8 months. Samples of 500 received were placed in earthenware jars surrounded by moist peat in a wooden crate in a cool, dark room. Samples of 507 were stored as received in glass vials at room temperature away from direct sunlight. Analyses were conducted as soon after receipt of the material as was normally feasible for laboratory routine.

Testing: Our laboratory analyzes dry and liquid manures, composts, plants and the like on a routine basis and this background has been used in deciding upon the most appropriate testing procedures for the respective samples. It is very likely that still other testing avenues exist and no claim to perfection is made here.

500: Bio-dynamic preparation 500, made from pure cow manure, is essentially similar to compost and was treated accordingly. In fact, so many published analyses exist for manure and its several stages of decomposition that the possibility of finding a unique interpretation is sharpened. This was grounds enough for at least one preparation 500 producer to refuse to submit a sample, asserting (without evidence) that we would fail to distinguish prepared 500 from any other composted manure sample! However, as far as we were concerned, either outcome would be as interesting, and no claims are made.

As the samples were received, the appearance and odor of each were noted, and a photograph was made on a dried sub-sample. Moisture was determined as oven-dry weight after 24 hours at 75°C. pH was measured by glass electrode in a slightly over-saturated sample paste; on the same paste the oxidation-reduction potential (ORP) was read by platinum electrode at 30 minutes and again after 36 hours; additionally, the conductivity of the paste was measured by an appropriate conductivity meter probe. Organic matter is determined by loss on ignition at 550°C in a muffle furnace for 1 hour; total-N as Kjeldahl N after suitable digestion in K_2SO_4 + $CuSO_4$ of undried samples. For calculating the carbon to nitrogen ratio carbon was assumed to be OM x .58. Ammonium and nitrate are measured simultaneously on buffered NaOAc extracts (pH 4.8); NH_3 (aliquot 1) by ammonia electrode (ORION # 95-10) after addition of NaOH, and NO_3 (aliquot 2) similarly by NH_3-electrode subsequent to addition of Devarda's Alloy and suitable reaction period; NO_3 is derived by subtraction of the N content of aliquot 1 from that of aliquot 2. Carbon dioxide respiration was measured on *as is* samples in 1-pint vessels containing NaOH solution and incubated at 32°C for approximately 30 hours; results are calculated as percent total carbon evolved as CO_2-C at the 24 hour point. Extract color is the color observed for 1:40 (sample:solution) extractions in buffered NaOH from NH_3 + NO_3 determinations. Circular chromatograms were performed on 6 hr 0.2N NaOH extractions of dried samples; the sample:solution ratio was adjusted according to organic matter and pH levels by a suitable regression equation (Brinton, 1982); this procedure eliminates gross appearance differences due only to different levels of organic matter or pH in the samples being tested. Evaluation of the $CoCl_2$ (cobaltous chloride)

crystallization was performed in a manner similar to Pfeiffer's $CuCl_2$ crystallization technique (Pfeiffer, 1961) in a 15 ft^3 cabinet heated to 30°C for 16-20 hours using varying sample:solution ratios. Finally, in a continuation of the testing, samples from 1983 will be tested and compared to those of the prior year.

507: Upon receiving the liquid valerian sample, color and odor were noted and the sample was photographed. pH was measured by a glass electrode on the *as is* solutions. Solids are determined as dry matter percent of the original solution (w/v) upon evaporative drying; solids organic matter is the loss on ignition at 550°C for 1 hour of the dried residue. Texture, whether gelatinous or lacking, is noted from the dried residue before furnace combustion. An alternative and quick measure of total dissolved solids is represented in the refractometer reading (National Hand Held Refractometer). Optical density is determined on diluted (1:10) samples in a Bausch & Lomb Spectrometer at 630 nanometers; samples were centrifuged for 5 minutes prior to making the reading. Chromatograms were performed on diluted (1:10) extracts on Whatman #4 paper sensitized with 0.5% $AgNO_3$; 1 drop of 10M NaOH is added to each 2.5ml of sample prior to chromatographing. Solution specific gravity was determined in 50ml cylinders with a hydrometer where sufficient sample was available. At the end of approximately 6 months of storage each sample was checked for odor level and pH. A negative value was assigned to all which had the putrid butyric acid-type odor and above neutral pH, considered a sign of spoilage. Samples which smelled poorly initially were invariably the same at this point, as it was not likely that fermentation leading to foul odors and high pH would be reversed.

Results

Test results are presented in Tables 1 and 2 for preparation 500 and 507, respectively. Additionally, chromatograms are shown in Diagrams 1 and 2. In Tables 3 and 4, data for 500 and 507 are represented in terms of minimum and maximum values for each measured trait with the corresponding mean and standard deviation.

Preparation 500:

The average analysis from Table 3a (including 3 samples from Europe) gives the following picture: The samples are moderately moist, moderately acid, moderately high in organic matter, moderately high in total nitrogen, moderately low in soluble nitrogen ($NH_3 + NO_3$), contain on the average 5.5 times more nitrate than ammonium

nitrogen (1.7 times on a molar ratio basis), are moderately low in CO_2 respiration and moderately to very well-oxidized.

The highlight of these features is the fact that the samples, though moderately moist, are very well aerated, judging from the internal oxidation status (redox) and the fact of their being more oxidized nitrogen (NO_3) than reduced (NH_3). It is also noteworthy that the organic and nitrogen contents are moderately high but the CO_2 respiration is low. In at least 3 samples the total nitrogen levels exceed what we would normally expect for fresh or composted cow manure.

For what it is worth, an interesting distinction is seen in comparing the 3 European samples with the American. Since only 3 samples are involved in the former group, one being 1 year old at the time of testing, the comparison must be read cautiously. Highlights are that the U.S. samples all have pH values well below neutral, while the European group is above neutral, as well as lower in nitrogen, organic matter and salts but showing a much higher level of CO_2 respiration. The appearance and texture were darker and finer than the American counterparts, all of these features indicative of increased mineralization.

Two of the samples were stored material of 1 or more years old. #0218 from Eastern U.S. was 3 years old (stored moist in a clay crock) and #0277 from Switzerland, 1 year old (storage method unknown). The stored European sample shows the lowest organic and nitrogen content for all the samples. However, the stored U.S. sample still shows moderate organic- and N-content but a very low pH. It is likely that the low pH has brought about a virtual state of preservation, as CO_2 respiration will be very low. Whether this is in the nature of preparation 500 — as seen from most of the sample results — remains to be seen.

As far as a comparison of these test results with data on manures and compost goes, some interesting points may be made. For one, it is unusual for material of this age to show moderately high levels of organic matter and nitrogen. Or, for materials having such an organic and nitrogen content, it is unusual that the CO_2 respiration will be so low; for comparison, we find in similar composts respiration values 2x to 10x higher. It must be pointed out that the pH is low in the materials on the average, and this could partly explain the low respiration. However, it is unusual, though theoretically not impossible, for the pH to be low in these manure samples. Normally, where the total nitrogen content is high the potential for ammonification and high pH's is likewise great. Also, where there is partial exclusion of air, as occurs in making the preparation, an anaerobic atmosphere will form,

favoring higher pH levels and ammonia. Experiments conducted in Dornach (Goldstein, 1978, personal communication) showed that where manure was buried in variously-sized vessels and bags it retained qualities of fresh, anaerobic manure in marked contrast to horn-manure. In view of these experiences and the test results seen here, there is strong evidence for aerating and stabilizing factors in the 500. It is obviously along these lines that interpretation of quality should be sought.

In addition to the tests on actual composition, all the samples were chromatographed as described earlier. Also, some of the samples were selected for $CoCl_2$ crystallization, as earlier research indicated that cobalt salts were sensitive to preparation 500 influences. The chromatograms do not show appreciable differences except that the samples from the U.S. show a slightly cruder appearance, most likely related to the fact that the organic content is higher than in the European samples. All chromatograms appear to be reasonably within limits of quality as suggested by published standards from the Biochemical Research Lab in Spring Valley, New York (Sabarth, 1962). Results from the crystallizations are as yet inconclusive. The patterns obtained with cobalt and 500 in solution were similar but significantly less defined than earlier work obtained at another location. After considerable effort the tests were discontinued in hopes of attempting them again with a new and fresher batch of 500.

Preparation 507:

The color of samples of 507 as received at the lab varied from pale amber to totally opaque brown. The tendency was for the lighter samples to smell better. As is not the case with preparation 500, there are several ways in which the valerian can be prepared and each person seems to have evolved his own approach. The techniques varied from putting blossoms through a meat grinder and pressing immediately with little or no addition of water to sun-steeping in glass jars with large amounts of added water and pressing later. Instructions on making the 507 extract vary somewhat, and Steiner was initially vague concerning this preparation. Koepf (manuscript, Emerson College) recommends sprinkling the valerian flowers with water for a few days after picking, then pressing the juice with a small fruit press. Gregg (manuscript, Threefold Farm) recommends using a meat grinder to grind the flowers after picking, and squeezing with little addition of water.

The results of testing preparation 507 are shown in Tables 2 and 4. Along with samples received from outside, we show several of our own preparations made by various methods (#0181 - #0184). Samples #0182

and #0183 are 2- and 1-year-old samples, respectively. Sample #0276, also our own, is from a batch prepared in 1975 and stored since that time in an amber glass-stoppered bottle.

In rating the odor level of the samples we distinguished on four levels: sweet and m-sweet mean an odor typical of fresh valerian; marginal is nearly odorless but slightly acrid; m-foul is beginning to be unpleasant; and, finally, foul is distinctly unpleasant as with butyric acid.

It was noted that several samples, upon drying, maintained a stiff, gelatinous or spongy texture while others were flat. Thus the two texture types were rated as having (+) or lacking (—) these qualities.

The pH of the samples varied tremendously from a low of 4.1 to a high of 8.3. There was a strong relationship of the odor to the pH; samples near or above neutral invariably smelled bad. Similarly, samples having low pH values showed the positive traits of texture upon drying, indicative of undecomposed organic compounds; e.g., saponins and the like (hypothesis). Similarly, the very dark extracts generally smelled bad, and the reddish-orange the best with the lightest extracts falling on both sides of odor. The determining factor appears to be dry matter (solids) content; samples having little dissolved material smell worse than those having high levels of dissolved matter. As the pH increases the solids content decreases. Likewise, the percent of solids which is organic decreases with increasing pH levels, an indication of increased fermentation and loss of substance.

The valerian samples can be placed into two groups:

	Group A.	*Group B.*
Odor:	marginal or poor-smelling	sweet, valerian odor
pH:	neutral to high pH	acidic
Color:	very light or very dark in color	medium red-yellow in color
Content:	medium to low level of solids; diminished level of organic matter	medium to high level of solids; high organic content in solids

The chromatograms have also clearly defined these two groups; those samples of Group A-type gave flat, mineralized-looking chromatograms of mostly pale, brown-gray colors, and Group B-type gave strongly formed, colorful patterns similar to fresh plant extracts.

Although the optical density relates clearly to the color level (rated 1 to 4 as described and regressed against the optical values), it is interesting to note the very different quality of the darkest extracts;

these are invariably placed in Group A. Thus, as will be discussed, achieving a dark extract alone is not a suitable criterion for successful preparation-making.

An attempt has been made to relate the methods of production of these samples to the quality traits as shown. Clearly, prolonged storage, such as in the case of samples #0182 and #0276, is associated with poorer odor, diminished solids content and increased pH. Apparently, some form of oxidative polymerization of the compounds present in the extract will take place over time, causing the color to become very dark. The oldest sample was in fact almost black in appearance. All the samples collected in this project had darkened before the completion of the project, as found from comparing color to the initial photos and by testing the optical density. These storage traits are integrated in a storage value indice, shown in Table 2. A positive sign (+) indicates qualities similar to Group B samples. As can be seen, several of the samples have lost some qualities during storage at room temperature. None of those samples of Group A-type have changed; only Group B samples have changed (for the worse). The change in some and not in others may be seen as related to one or another marginal trait found in the initial analysis, most particularly medium to low solids contents.

As far as actual methods of production go, some comparisons are afforded by the fact that we deliberately prepared valerian extracts in different ways, and two other persons submitted samples also similarly different. Sample #0180 was prepared by grinding blossoms in a meat grinder immediately after picking, with the addition of only a very little water to dampen the flowers. Alternatively, #0181 was similarly ground but allowed to steep outdoors in a large jar with some added water for a period of 3 days. As with #0180, it was placed in a hand-press and the juice expressed after this point and bottled with an air-lock to prevent oxygen entry but to allow pressure releases. These samples did not ferment much, as they reached a low pH within hours after grinding. The difference in quality as seen from the tests was very small. The second method of preparation involved less work initially but more work overall. Sample #0184, from the same batch of flowers, was initially chopped with a knife and allowed to sun-steep in large clear glass jars. Blossoms were pressed into the jar and enough water added to cover them completely. At the end of one week, the material was passed through the meat grinder and hand-pressed and bottled. This method involved some sacrifice of solids content over the first two, but the quality characteristics were nonetheless good and above average as far as all the samples go.

Another set of comparisons may be seen in samples #0219 - #0221. Sample #0219 was prepared by putting the blossoms through a screw-type power expeller (probably more time-consuming than hand grinding, though less tiring), using only a very small addition of water. The sample was bottled and loosely capped. This produced a Group B-type sample, high in solids and low in pH, but it has not stored well (probably related to the fact of not tightly stoppering the bottle initially). Samples #0220 and #0221 are variants of the above, only a blender and food mill, respectively, were used to prepare the blossoms; 4 parts water were added to each part of blossoms, and the samples were bottled after grinding. These two samples obviously fall into the Group A category, with near-neutral pH, high odor, and low solids content. Sample #0222 was prepared in a fashion similar to #0221, only it is 4 years old. It shows slightly diminished qualities over the previous two.

A final comparison in methods of production is seen in samples #0310 and #0311, prepared by grinding and steeping, respectively (no other information available). Grinding here produces higher values for most measured traits. However, both samples are low in solids and gave Group A-type chromatograms; additionally, neither of the samples stored well. It is possible that refrigerator storage would have prolonged the life.

Conclusions

In the foregoing project we have attempted to characterize the type of composition found in several samples of the bio-dynamic preparations 500 and 507 acquired from the United States (and a few from Europe). It has been our hope to gain a unified picture from this work which may be useful in a practical understanding of quality in the preparations. It was thought that the project would at least give some idea of the limitations involved in this approach.

Results from testing horn-manure 500 revealed several interesting traits from which one may glimpse something of the dynamic nature of the fermentation process. Evidently, factors favoring internal aeration and stabilization of nitrogen and organic matter are present. These are the sort of qualities which should lead one independently to deduce a favorable soil and humus influence.

There are several limitations, however, in taking the data for 500 and using it in an absolute sense to interpret quality. Few of the measured traits showed significant correlations with others, so explanations on how the preparation came to have the traits cannot be

advanced. This is not unusual, particularly when a sample which has undergone a living process is abstracted by testing at one point in time. Also, we do not have a sample of very obviously poor quality with which to contrast these materials. Some samples submitted were suspected to be poor, but not very obviously. Thus, a worthwhile approach for further confirmation of these results would be to prepare samples of 500 in varying ways. Scientifically it would be appropriate to show analyses of the source material, before fermentation. This would particularly help explain, for example, whether the nitrogen is in fact increasing. It would also give a clearer idea on how far the decomposition went. The comparison between samples from different continents might also be extended.

The results with 500 confirm in part conclusions that Pfeiffer (1948) had reached in his studies on the material. He found similar qualities of aeration and presence of nitrate which he considered significant. He also speculated that nitrogen must be fixed during the fermentation process, although we do not know how he arrived at this hypothesis. In recent microbiological studies, samples of 500 have been reported to show extremely high levels of azotobacter (nitrogen fixing) micro-organisms (Stern, 1976). Whether nitrogen fixation actually takes place in what otherwise would appear to be a nitrogenous manure atmosphere remains to be dealt with.

Our results obviously support the general practice of gauging the quality of 500 by appearance and particularly by odor (or lack of). It is hoped that the presentation of this data will be viewed as a proposal to substitute abstract testing for sensory observation. Through confirming our senses, and supporting other and new pictures on the material, the testing may have positive, meaningful value.

With regard to the test results for valerian preparation 507, several comments on quality are appropriate. If we should first consider the ideal of the preparation, that is, to capture the essence of the valerian blossom, then the direction that interpretation should take may be clear. These results show that it is possible to preserve in the extract several fresh qualities, but that also another form of fermentation may interceed, yielding a darker, earthy or foul-smelling solution, apparently lacking all the original qualities. Through associating qualities of the latter with a condition of increased decomposition (diminished solids, less organic content, higher pH), it is felt that this condition is clearly undesired. Most likely a lactic acid type fermentation is responsible for the favorable preservation, whereas with the higher pH samples the fermenting goes in a butyric acid type direction

involving generation of odor and increased losses of substance, though not of color.

Apparently the method of production is not critical so long as the solids content is not overly diluted by additions of water. Using water additions of up to 1:1 on a weight basis and steeping for several days we have produced extracts of high value. Apparently there are only so many solids which can be water-dissolved from the blossom; achieving a solution content of around 5% solids may be the maximum possible. It is important that the samples be properly bottled and capped afterwards, as this shapes the nature of the fermentation. Obtaining a thick initial extract is not alone a guarantee of good quality. Extreme efforts at pulverization, particularly with machines, are therefore thought to be unnecessary and perhaps undesirable. We want somehow to elicit the blossom quality without producing a blossom "sludge", much of which will precipitate out in the jars later, anyway.

The aging process of valerian is interesting, since the color intensifies as the solids decrease; thus, color alone may not be a criterion of quality. An intermediary color type of red-yellows is suggested by the test results to be desired above others. If during storage the color changes and a loss of aroma takes place, then most likely the fermentation has gone in the other direction of higher pH and subsequent loss of initial value. The actual period of time that the sample may be stored appears to be largely a matter of how good the initial quality is. Storage life is restricted for samples which, though initially good, have low solids content. If questions of quality arise the author will be happy to have samples referred to him.

This project has been made possible in part by a grant from the Bio-dynamic Farming & Gardening Association.

The original paper includes, in addition to those published, two tables showing the correlation analysis of each preparation. People interested in these figures are invited to request them from Mr. Brinton.

June 30, 1983

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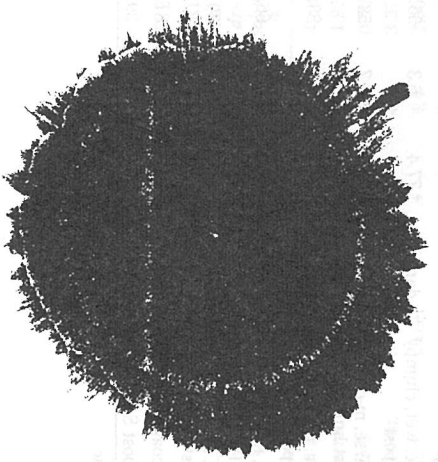
TYPE A (507) TYPE B



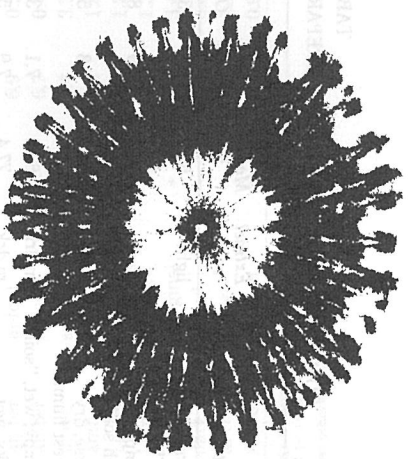


TABLE 1

COMPOSITION OF BIO-DYNAMIC PREPARATIONS (#500) (Sampled July-November 1982)

Sample #	*Region*	*Appearance & Odor*	*Extract color*	*Moisture %*	*pH (H_2O)*	*OM5*	*Total - N%*	*C:N*	*NH_3-N ppm*	*NO_3-N ppm*	*CO_2-C % in 24 hr.*	*Redox mV fresh/24 hr.*	*Salts mmhos/ cm^2*
0216	NE	coarse, dry "forst humusy"	light	52.2	5.7	38.1	1.68	13.2	90	554	.214	+365/345	3.6
0217	E	clumpy, wet "rich soil"	dark	79.7	5.9	80.1	3.03	14.9	189	246	.329	+350/340	2.8
0218 (1979)	E	coarse, dry "forest humus"	med-l	63.1	3.8	54.5	1.93	16.4	129	563	.048	+270/270	5.2
0223	EU*	clumpy, wet, "soil"	m-drk	67.4	7.1	37.9	1.54	14.3	157	1195	.508	+379/370	1.2
0276	EU	sticky, wet, m-coarse, "compost"	m-drk	77.4	7.9	58.5	2.40	14.1	625	57	.707	+420/-62	0.9
0277 (1981)	EU	sticky, wet, fine "comp"	light	70.0	7.3	19.4	0.90	12.4	123	658	.115	+410/360	1.4
0225	MW	coarse, wet, clumpy "compost"	dark	77.4	6.3	55.9	2.10	15.4	132	1006	.225	+365/365	2.7
0273	E	m-coarse, m-dry "forest humus"	med-l	63.5	6.7	58.5	2.70	12.5	125	1783	0.83	+340/330	8.5
0274	NE	coarse, m-clumpy "compost"	m-drk	74.9	5.1	83.2	4.03	11.9	5470	2188	.282	+315/295	4.6
0309	E	loose, m-wet "compost"	med-l	67.0	5.5	66.5	2.27	17.0	90	1526	.140	+340/340	3.0
0318	SE	loose, m-wet "forest humus"	med-l	70.7	5.3	89.2	3.48	14.9	1451	1672	.530	+345/335	2.5
0355	NE	med-coarse, loose	m-drk	54.8	5.9	81.9	1.77	26.8	2904	1056	.180	+300/220	3.4
0401	**	Compost Starter	dark	0.0	5.3	39.5	1.28	17.9	262	tr.	.077	+230	8.2

*EU = Europe; MW = Midwest, etc.

TABLE 2

PREPARATION 507 (VALERIAN) COMPOSITION

Sample	*Region**	*Color*	*Odor*	*Texture (dry)*	*pH*	*dry Solids %*	*Solids OM%*	*O.D.^{c} 630um*	*% refrac. solids*	*sp. gr. g/ml*	*cond. mmhos*	*6 mo. Storage value*
0180	NE	m-red	sweet	+	4.6	4.89	96.4	.158	5.9	1.022	6.6	+
0181	NE	m-red	sweet	+	4.3	4.87	83.0	.108	5.9	1.022	7.2	+
0182	NE (1980)	dark	foul	—	6.9	0.90	78.7	.240	1.4	1.018	3.2	—
0183	NE (1981)	red-br	m-sweet	+	4.8	3.37	80.4	.119	3.8	1.014	8.9	+
0184	NE	amber	sweet	+	4.4	2.80	85.4	.046	3.0	1.014	6.2	+
0215	NE	v. dark	foul	—	7.5	2.20	70.9	.276	2.8	1.014	7.1	—
0219	MW	red-br	m-sweet	+	4.4	5.29	88.9	.137	5.5	1.026	5.5	—
0220	MW	amber	foul	—	6.4	0.63	78.7	.061	0.5	1.004	2.1	—
0221	MW	amber	m-foul	—	6.9	0.50	77.8	.051	0.2	1.004	1.8	—
0222	MW (1978)	amber	m-foul	—	6.7	0.43	76.2	.020	0.2	1.005	2.6	—
0224	MW	m-red	sweet	+	4.4	3.30	83.9	.114	3.2	1.016	5.2	+
0270	E	amber	m-sweet	+	4.3	1.81	83.6	.043	1.8	1.010	3.6	+
0271	E	l-amber	m-sweet	$\underline{+}$	4.2	1.21	86.2	.032	1.1	1.008	2.8	—
0272	E	l-amber	m-sweet	+	4.3	1.35	85.9	.010	1.2	1.010	3.1	—
0275	EU	dark	marginal	+	4.9	3.46	73.9	.174	4.2	1.018	7.2	—
0276	E (1975)	dark	m-foul	—	8.3	0.67	71.1	.250	1.1	1.016	4.4	—
0310	E	m-red	sweet	+	4.6	1.19	87.4	.190	2.0	nss	2.5	—
0311	E	m-red	m-sweet	+	4.1	0.93	74.7	.110	1.5	nss	1.7	—

NOTES: for texture det'm (+) = spongy texture, (—) = no texture, ($\underline{+}$) = marginal for storage value, (+) = good, (—) = spoiled

*All samples from 1982 batches unless otherwise indicated

TABLE 3A: *All Samples*
PREPARATION 500: SUMMARY DATA

Variable:	*Moist.*	*pH*	*OM %*	*Total N %*	*C:N*	*NH_3-N ppm*	*NO_3-N ppm*	*$\frac{NO_3\text{-}N}{NH_3\text{-}N}$*	*CO_2-C % of C_t*	*Redox mV*	*Conduc. mmhos*
Minimums:	52.2	3.8	19.4	0.90	11.9	90	57	0.09	0.048	270	0.90
Maximums:	79.7	7.9	89.2	4.03	26.8	5470	2188	16.95	0.707	410	8.50
Mean:	68.2	6.0	60.3	2.32	15.3	957	1042	5.46	0.280	346	3.31
SD:	8.7	1.1	21.2	0.87	3.9	1651	656	5.53	0.204	37	2.07

TABLE 3B: *American Samples*

Minimums:	52.2	3.8	38.1	1.68	11.9	90	246	0.36	0.048	270	2.50
Maximums:	70.7	6.7	89.2	4.03	26.8	5470	2188	16.95	0.530	365	8.50
Mean:	67.0	5.6	67.5	2.55	15.9	1175	1177	5.84	0.226	332	4.03
SD:	9.6	0.8	17.1	0.81	4.4	1874	654	6.14	0.145	46	1.90

TABLE 4
PREPARATION 507: SUMMARY DATA

Variable:	*Color*[1]*	*Odor[2]*	*Text[3]*	*pH*	*dry Solids*	*refrac. Solids*	*OM % Solids*	*Optical Density*	*Conduc. mmhos*	*sp. gr. g/ml*
Minimums:	1.0	0.0	0.0	4.1	0.43	0.20	70.9	0.01	1.7	1.004
Maximums:	4.0	1.0	1.0	8.3	5.29	5.90	96.4	0.28	8.9	1.026
Mean:	2.72	0.6	0.6	5.3	2.21	2.51	81.2	0.12	4.5	1.013
SD:	0.96	0.5	0.5	1.4	1.6	1.9	6.7	0.08	2.2	1.006

[1]Color scale of 1 to 4; 1 = pale amber, 2 = amber, 3 = reddish, 4 = very dark
[2]Odor scale of 0 or 1; 0 = poor smelling (inc. marginal), 1 = sweet, valerian aroma
[3]Texture scale of 0 or 1; 0 = no texture on drying, 1 = textured on drying

*Note: Number scales used in correlation analysis (see Table 4A)