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FINAL REPORT

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METABOLIC STUDIES OF ASPARTAME AND MSG
INGESTED AS A MEAL COMPONENT

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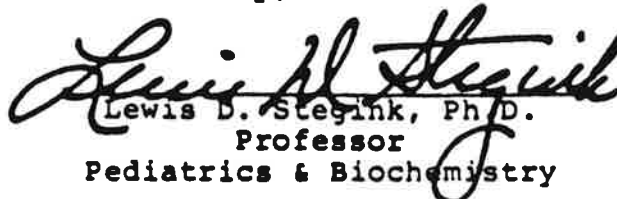
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INTRODUCTION

In the past year we have generated considerable information on plasma amino acid levels following an acute load of ASPARTAME administered to healthy adult male and female subjects in the fasting state (1-4). Doses of ASPARTAME ranging from 34 to 200 mg per kg body weight were administered in orange juice. The volume of orange juice varied from 70 to 500 ml. Under these conditions we have observed a dose-related response to ASPARTAME loading for plasma phenylalanine concentrations. Plasma concentrations of aspartate show a threshold rather than a dose response (1). Peak concentrations in plasma phenylalanine and aspartate occur within 60 to 90 minutes after loading.

We have observed that when monosodium glutamate (MSG) is administered to three-day-old pigs or lactating women in conjunction with a formula meal the time of onset of peak concentration of plasma glutamate, glutamine or alanine is delayed (5,6).

The metabolism of glutamate and aspartate is interrelated. Glutamate loads produce a rise in plasma concentrations of aspartate as well as glutamate (5-7). Conversely, ASPARTAME loads produce a slight rise in plasma concentrations of glutamate (1-4).

It has been suggested that the addition of glutamate (MSG) and ASPARTAME might produce a very rapid increase in plasma glutamate and aspartate levels when administered with a protein meal (8-10). This has led to the suggestion that the

metabolism of these two food additives might decrease when ingested as part of a high protein load. Such conditions were postulated to produce elevated glutamate and aspartate levels and potential neurotoxicity (8,9).

In animal species which are susceptible to dicarboxylic amino acid induced neuronal necrosis, the infant of the species is most susceptible (11,12). The reason for this lies in part in a decreased metabolic capability of the neonate to handle glutamate and aspartate, resulting in higher blood levels per unit dose (13). This is particularly true for the most susceptible species, the neonatal mouse.

However the most critical animal species, the infant subhuman primate, does not appear susceptible. Initial reports of dicarboxylic amino acid induced neuronal necrosis in the infant monkey by Olney and colleagues (14,15) have not been confirmed in other laboratories (7,16-20). Our data indicate that the neonatal primate tolerates enormous elevations of plasma glutamate and/or aspartate levels without neuronal necrosis (7,16).

The mouse data have raised questions about the ability of man to metabolize large quantities of dicarboxylic amino acids. However, even the sensitive neonatal mouse requires gross elevations of plasma dicarboxylic amino acid levels (13). Thus, it is highly unlikely that toxic effects from dicarboxylic amino acids will occur when plasma levels remain within post-prandial limits.

This report describes experiments designed to answer the following questions:

1. What changes occur in the plasma aminograms of normal adults following ingestion of a test meal containing 1 gm protein/kg body weight?
2. What changes occur in the plasma aminograms of normal adults following ingestion of this meal modified to contain MSG at 34 mg/kg?
3. What changes occur in the plasma aminograms of adults following ingestion of this meal modified to contain both ASPARTAME (34 mg/kg) and MSG (34 mg/kg)?

EXPERIMENTAL DESIGN

Study I:

This study was designed to determine the effect of a high protein meal with and without additional monosodium glutamate (34 mg/kg) upon plasma amino acid levels.

A total of 12 adult subjects were studied, 6 male and 6 female. Six subjects (3 male, 3 female) were fed the test meal without any additions. These six subjects also participated in Study II. The other six subjects were fed the test meal to which 34 mg of monosodium glutamate per kg body weight had been added. The test meal was given at 0800 hours following an overnight fast. Blood samples were drawn at 0, 0.25, 0.50, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, and 8 hours after the meal. After ingestion of the meal, no other food was permitted for 8 hours, although water was allowed ad libitum.

Blood samples for amino acid analysis were centrifuged immediately to separate plasma and erythrocytes. The plasma was deproteinized with sulfosalicylic acid (21) and either analyzed immediately or stored at -70°C until analysis, to prevent loss of glutamine and cystine (22,23). Amino acid analyses were carried out on Beckman 121 M amino acid analyzers.

The test meal was a "sloppy joe" consisting of a bun with lean ground beef and 150 ml of a vanilla-flavored milk shake (Table 1). Monosodium glutamate (MSG) to provide 34 mg/kg was added to the ground beef. No additions to the milk shake were made. The individual loads of glutamate, aspartate and phenylalanine in these meals are found in Table 2.

All subjects were screened within one week prior to admission to the study. Screening tests included physical examination, complete blood count, urinalysis, pregnancy test (female subjects), SMA 12/60, SMA 6/60 and plasma aminograms.

The proposed study was explained to each subject, and informed written consent was obtained. The protocol had been reviewed and approved by the Committee on Research Involving Human Subjects of the University of Iowa.

Study II:

This study was designed to evaluate the effect of added monosodium glutamate (MSG) plus ASPARTAME (34 mg/kg each) upon plasma amino acid levels.

Three male and three female subjects were studied in a cross-over design, with one feeding being a test meal, the other a test meal containing ASPARTAME at 34 mg/kg and MSG at 34 mg/kg. The test meal was given at 0800 hours following an overnight fast. Blood samples were drawn at 0, 0.25, 0.50, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, and 8 hours.

The test meal was a "sloppy joe" consisting of a bun with lean ground beef and 150 ml of a vanilla-flavored milk shake (Table 1). ASPARTAME to provide 34 mg/kg was added to the milk shake and MSG to provide 34 mg/kg was added to the hamburger when those components were added. The test meal with and without ASPARTAME plus MSG was presented to the subjects on a randomized basis. The total protein load was 1 gm/kg body weight. The individual loads of glutamate, aspartate, and phenylalanine found in these meals are shown in Table 2.

All subjects were screened within one week prior to admission to either study. Screening tests included physical examination, complete blood count, urinalysis, pregnancy test (female subjects), SMA 12/60, SMA 6/60, and plasma aminograms.

The proposed study was explained to each subject, and informed written consent was obtained. The protocol had been reviewed and approved by the Committee on Research Involving Human Subjects of the University of Iowa.

Blood samples for amino acid analysis were centrifuged immediately to separate plasma and erythrocytes. The plasma

was deproteinized with sulfosalicylic acid (21) and either analyzed immediately or stored at -70°C until analysis to prevent loss of glutamine and cystine (22,23). Amino acid analyses were carried out on Beckman 121 M amino acid analyzers.

RESULTS

Plasma amino levels in the subjects studied are found in Tables 3-5. Table 3 contains levels noted in subjects after ingestion of the "sloppy joe" meal alone. Table 4 contains plasma levels in subjects after ingestion of the "sloppy joe" meal containing an additional 34 mg of MSG/kg body weight. Table 5 contains the plasma levels in subjects after ingestion of the "sloppy joe" meal to which both MSG (34 mg/kg) and ASPARTAME (34 mg/kg) had been added. At the 1 gm/kg load of protein studied, most plasma amino acid levels peaked between 4-6 hours after ingestion of the load as illustrated for leucine, isoleucine and valine in Figure 1. This figure compares the values obtained after the meal alone and the meal plus both ASPARTAME and MSG. The effects of the various meals on plasma glutamate levels are shown in Figure 2. The addition of MSG, or the addition of ASPARTAME plus MSG had no effect upon the plasma glutamate curves. Particular attention was given to the early phase of the meal, since Olney, (8,9) proposed that the addition of MSG alone, and particularly addition of ASPARTAME plus MSG would result in an early peak elevation of plasma glutamate and aspartate levels. Olney

associated such predicted elevations in the levels of glutamate and aspartate with potential neurotoxicity. In our studies blood samples were obtained at 15 minute intervals for the first hour after loading, and at 30 minute intervals until two hours. The addition of MSG, or of MSG plus ASPARTAME did not significantly alter the plasma amino acid levels above those normal postprandial levels observed after ingestion of the meal alone. Similar data for plasma aspartate levels are shown in Figure 3.

The phenylalanine content of the meal with added MSG and ASPARTAME is approximately one and one-half times that of the meal alone (Table 2). However, plasma phenylalanine and tyrosine levels noted after ingestion of the meal plus MSG and ASPARTAME were only slightly higher than those noted after ingestion of the meal alone. All levels were within the normal postprandial limits reported for young infants (31).

DISCUSSION

The quantity of MSG and ASPARTAME used in this study is considerable. The data accumulated by the Committee on GRAS List Survey--Phase III (24) indicates that the mean daily intake of MSG approximates 100 to 225 mg for persons two years of age and over.

The data (Table 6) accumulated by the Committee on GPAS List Survey--Phase III (24) indicate that the expected mean daily intake of MSG was 6.8 mg/kg/day for the age group ingestion

the largest quantity of MSG on a per kg basis (12-23 months of age). Their data indicate a daily intake of 30 mg/kg at the 90th percentile, and an intake of 61 mg/kg at the 99.9th percentile in this group. If we assume that this MSG is ingested over the course of three meals, an individual at the 99.9th percentile would ingest approximately 20 mg added MSG/kg/meal. Thus, the load tested (34 mg/kg) is large.

Similarly, as summarized in Table 7, the ASPARTAME load is also large. A typical 70 kg man may be considered to have an energy requirement of about 2500 kcal per day. Approximately 17% of these kcal are ingested as sucrose (25). Thus, sucrose ingestion per day is about 1.5 g/kg. This is equivalent to 7.5 to 8.3 mg/kg ASPARTAME, considering sweetening power to be 180 to 200 times that of sucrose.

If the total carbohydrate intake of our subject is assumed to be 50% of total calories, about 313 g of carbohydrate are ingested. If all this carbohydrate is ingested as sucrose, the subject would ingest 4.47 g/kg over the entire day. If the sweetening equivalent of this amount of sucrose were ingested as ASPARTAME, the subject would ingest 22-25 mg/kg ASPARTAME over the course of the entire day. In the present study, ASPARTAME was administered at 34 mg/kg in a single dose. This dose is estimated to represent the 99th percentile of daily intake when ASPARTAME replaces dietary sucrose (26).

The results of the present study clearly demonstrate that plasma glutamate and aspartate levels are not elevated beyond usual postprandial concentrations despite the administration

of large doses of MSG AND ASPARTAME.

The potential toxicity of the dicarboxylic amino acids, glutamate and aspartate, is particularly controversial. There is no doubt that large doses of these amino acids administered to the young rodent produce markedly elevated plasma levels of these amino acids (13,27) and hypothalamic neuronal necrosis (11,12). These amino acids will also produce a lesion in the adult mouse (12), but much higher doses are required, at least in part, because of the increased ability of the adult animal to handle glutamate and aspartate (13). The results in the neonatal primate are controversial. Olney and colleagues reported that high doses of glutamate resulted in neuronal necrosis (14,15). However, four other laboratories have failed to duplicate these results (7,16-20), even the presence of markedly elevated plasma glutamate and aspartate levels (7).

In the neonatal mouse, the animal species most sensitive to dicarboxylic amino acid induced neuronal necrosis, marked elevations in plasma levels must be attained before toxic effects are noted. Stegink *et al.* (13) reported that plasma dicarboxylic amino acid levels must reach 50-70 μ moles/dl before toxic effects are noted in the 10-day old mouse. In the infant monkey, by contrast, plasma dicarboxylic amino acid levels of 500 μ moles/dl failed to produce neuronal necrosis (7). Thus, the failure to elevate aspartate or glutamate levels beyond normal postprandial limits at the high dose levels of ASPARTAME and MSG administered indicates no hazard, since even the high

sensitive mouse experiences no effect with the levels noted in this study.

The rapid metabolism of ingested glutamate and aspartate is not surprising. Windmueller and Spaeth reported very rapid metabolism of glutamate and aspartate by the intestine in vivo (28,29). In addition, dietary protein contains large quantities of aspartate and glutamate which are readily metabolized (30).

The addition of ASPARTAME (34 mg/kg) to the meal increased the phenylalanine content from 43 to 64 mg/kg (Table 2). The increased phenylalanine content did result in increased plasma phenylalanine and tyrosine levels, as shown in Figure 4. Although levels of these amino acids were significantly greater in the early time periods (first two hours), the curve was a smooth one, and no rapid spiking of phenylalanine or tyrosine values was noted. The values observed fit predicted curves. Phenylalanine derived from ASPARTAME is already in peptide form, and accessible to the peptide absorptive sites in the intestinal mucosa (32,33). Thus, we expected slightly increased phenylalanine levels in the early part of the time curve where the phenylalanine derived from the protein fraction is not as available because of limited proteolysis.

The increased phenylalanine levels noted after ASPARTAME addition to the meal are well within the normal postprandial range which we have observed in term infants after normal formula feedings (31). The levels observed are markedly

below those phenylalanine levels associated with toxicity in the young infant. In children with "classical phenylketonuria" plasma phenylalanine levels exceed 180 μ moles/dl (30 mg%) and range up to 600 μ moles/dl (34,35). Lower phenylalanine levels, 30-60 μ moles/dl (5 to 10 mg%), have been noted in the variant forms of phenylalaninemia, but are not associated with mental retardation (34,35). In the present study, phenylalanine levels were within normal postprandial limits (12 ± 3 μ moles/dl) after addition of ASPARTAME to a high protein meal at 34 mg/kg. This indicates little hazard from the phenylalanine associated with ASPARTAME ingestion at this level.

SUMMARY

The data obtained indicate that the addition of MSG alone, or of ASPARTAME plus MSG to a high protein meal at the levels tested had little effect upon the plasma aminogram. Plasma levels of aspartate, glutamate, phenylalanine and tyrosine did not show an early rapid rise resulting from the administration of MSG and ASPARTAME. These data conclusively disprove suggestions made by Olney (8,9) and Reif-Lehrer (10) about the effects of ASPARTAME and MSG added together to food systems.

PUBLICATION

The data from this study will be presented at the April, 1977, meeting of the American Institute of Nutrition and has been published in abstract form:

Baker, G.L., Filer, L.J., Jr., and Stegink, L.D.:
"Plasma and erythrocyte amino acid levels in normal adults fed a high protein meal: Effect of added monosodium glutamate (MSG) or monosodium glutamate plus ASPARTAME." Fed. Proceed. 36, 1154, 1977.

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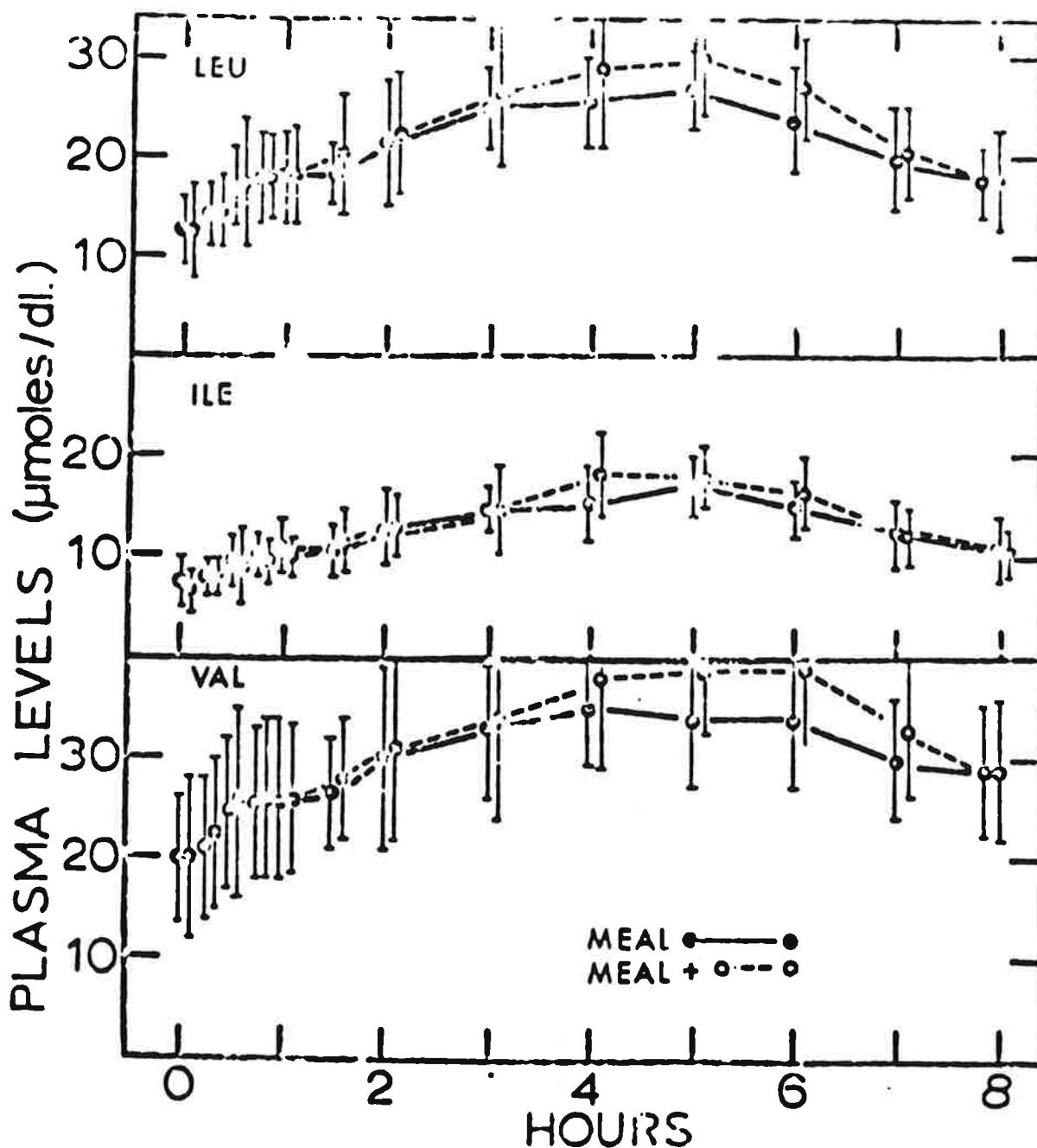


Figure 1: Plasma levels of leucine, isoleucine and valine (mean \pm 1 standard deviation) in normal adult subjects after ingestion of a high protein meal (1 gm/kg) alone \bullet — \bullet or with 34 mg/kg MSG plus 34 mg/kg ASPARTAME \circ --- \circ added. The values are obtained from the same six subjects in a cross-over study.

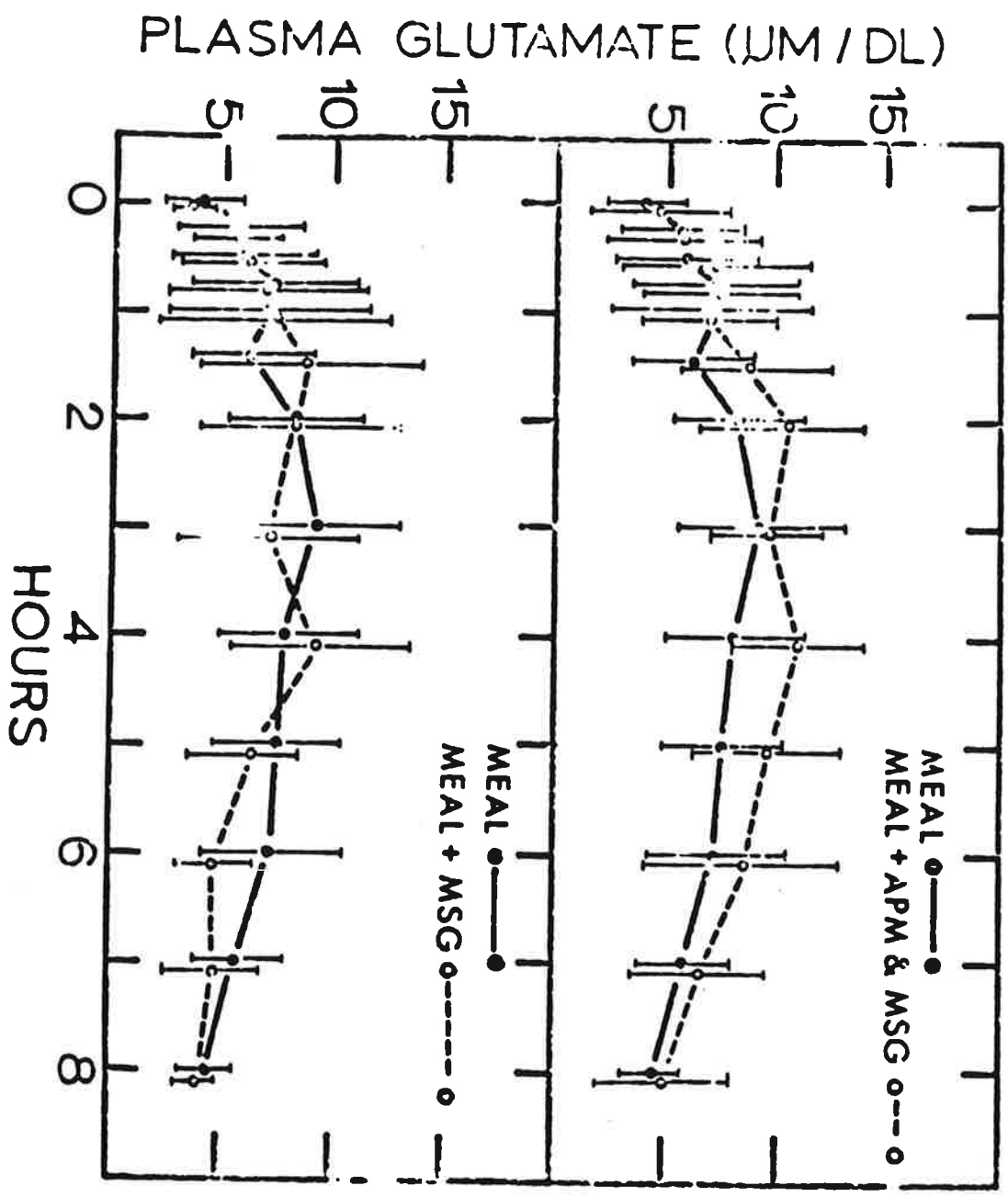


Figure 2: Plasma glutamate levels (mean \pm 1 standard deviation) in normal subjects after ingestion of a high protein meal alone or with 34 mg/kg MSG added or with 34 mg/kg MSG plus 34 mg/kg ASPARTAME added.

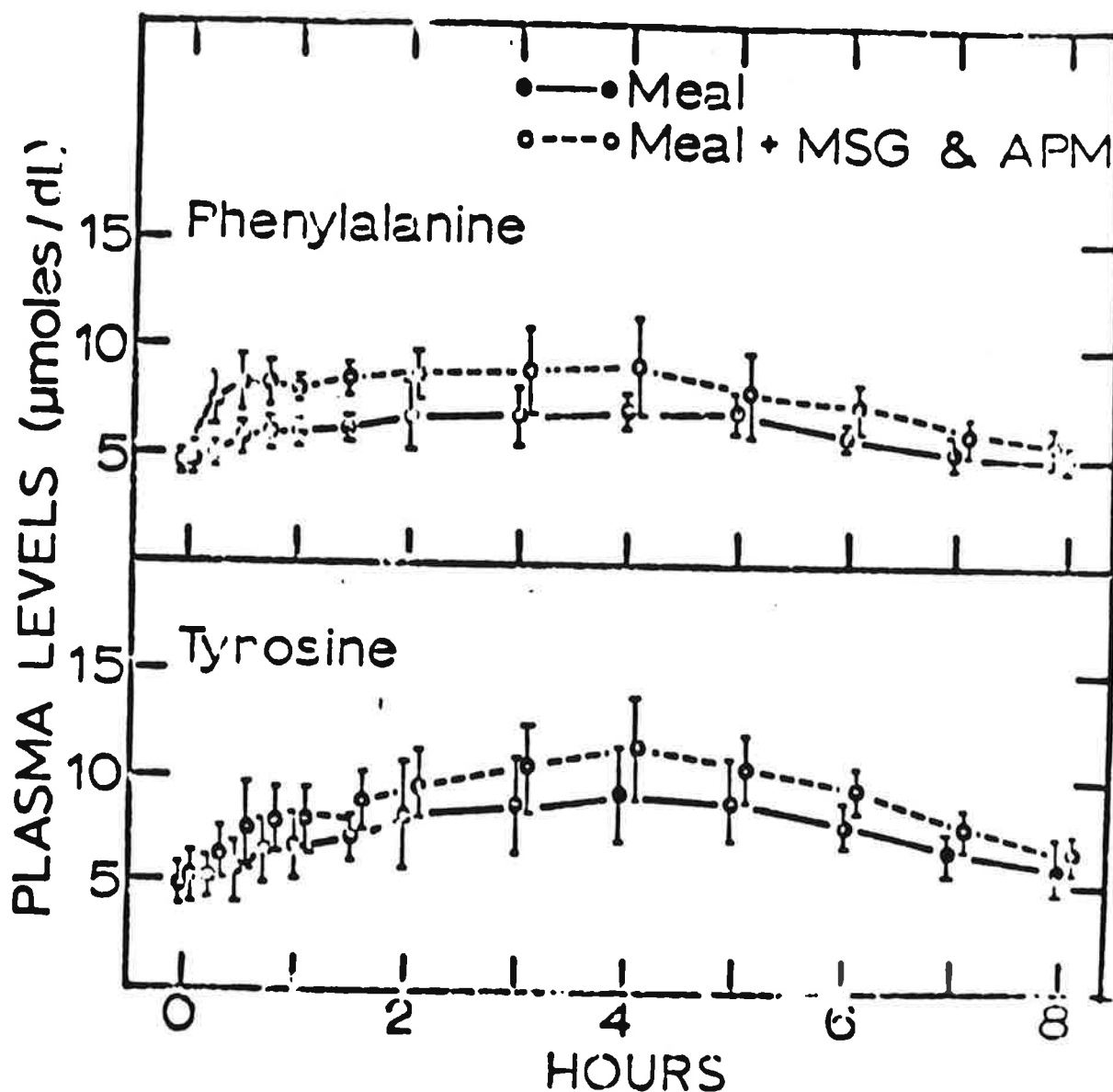


Figure 4: Plasma phenylalanine and tyrosine levels (mean \pm 1 standard deviation) in normal subjects after ingestion of a high protein meal (1 gm/kg) alone or with 34 mg/kg MSG plus 34 mg/kg ASPARTAME added.

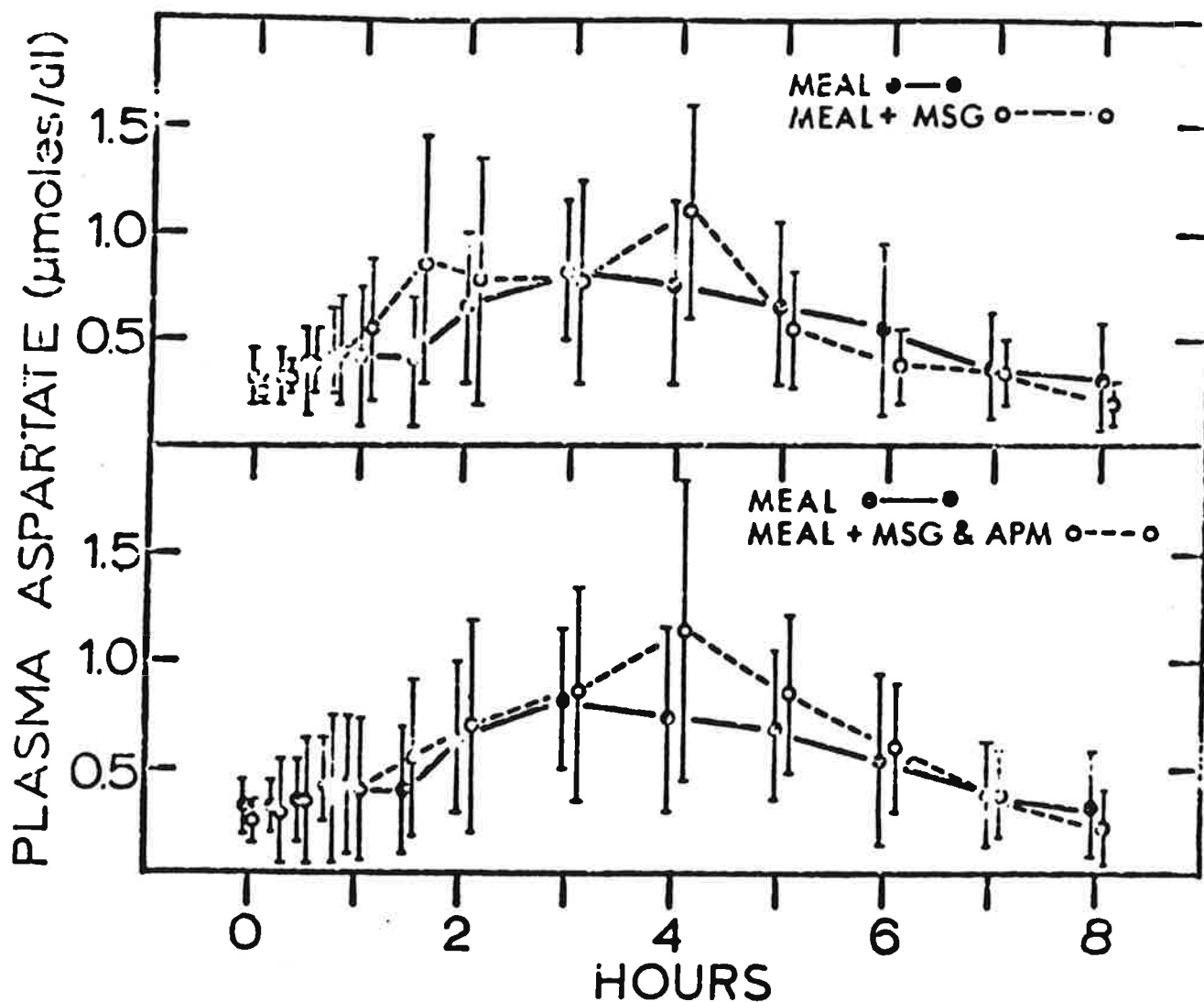


Figure 3: Plasma aspartate levels (mean \pm 1 standard deviation) in normal subjects after ingestion of a high protein meal (1 gm/kg) alone or with 34 mg/kg MSG added or with 34 mg/kg MSG plus 34 mg/kg APM added.

Table 1
COMPOSITION OF TEST MEAL FOR A 70 KG ADULT

Component	Quantity gm	Protein gm	Fat gm	CHO gm	Energy kcal
Hamburger	222	61	25.5	0	346
Bun	50	4.5	1.5	25.5	133
Milk	100	3.5	3.5	5	66
Ice Cream	50	2	5	11	95
Total	442	71	35.5	72	640

Protein - 38% of total energy

For the 70 kg person, the meal supplies about 1 gm/kg body weight as protein. Quantity of the hamburger in each meal was varied with each individual so as to provide protein at 1 gm/kg body weight.

Table 2
ESTIMATED INTAKE OF PROTEIN, ASPARTIC ACID,
GLUTAMIC ACID AND PHENYLALANINE IN MEAL STUDIES

Study	Protein g/kg	Aspartate mg/kg	Glutamate mg/kg	Phenylalanine mg/kg
Hamburger- Shake	1.0	90	171	43
Hamburger- Shake with MSG	1.0	90	198*	43
Hamburger- Shake with APM & MSG	1.0	103	198*	64

*Corrected for the sodium content and water of hydration of
MSG

(78% of MSG is glutamate).

MEAL ONLY

PLASMA AMINO ACIDS, DOSE = 0	0	15	30	45	60	90	120	180	240	300	360	420	480
TIME (MIN)	0	15	30	45	60	90	120	180	240	300	360	420	480
TAURINE	5.19	4.44	4.85	5.22	6.01	6.89	7.24	6.58	6.27	5.55	5.70	5.88	5.30
Std. Dev.	0.67	0.64	0.73	1.19	1.53	1.96	1.40	0.96	1.04	1.61	2.28	2.94	1.88
ASPARAG	0.32	3.32	0.36	0.43	0.42	0.40	0.64	0.83	0.74	0.68	0.54	0.37	0.32
Std. Dev.	0.15	0.12	0.22	0.27	0.32	0.31	0.35	0.33	0.39	0.38	0.39	0.26	0.27
THREON	14.18	15.67	17.29	18.91	19.08	19.91	21.69	22.50	22.45	20.90	18.91	16.90	15.14
Std. Dev.	3.75	3.97	4.08	4.84	5.10	3.82	5.71	5.86	5.50	5.62	4.20	3.04	3.34
SERINE	10.44	11.93	13.97	15.62	14.90	14.96	14.92	14.79	15.63	13.61	12.24	11.19	11.30
Std. Dev.	1.40	3.13	4.32	4.95	4.50	3.92	3.71	2.51	4.69	3.26	2.87	2.90	2.54
ASPARAGN	3.87	4.32	5.41	6.52	6.45	6.74	7.55	7.30	7.33	6.67	5.60	4.24	4.19
Std. Dev.	3.31	2.32	1.73	1.00	1.22	1.04	1.30	1.99	2.04	2.43	1.30	1.57	0.52
GLUTAMIN	60.08	57.74	62.74	63.33	64.28	67.49	68.70	64.38	68.25	62.90	61.84	58.35	52.95
Std. Dev.	7.97	8.65	6.36	8.74	8.22	8.76	12.90	9.61	9.59	13.25	13.99	13.45	9.66
GLUTAMAT	4.02	5.61	5.72	7.11	6.92	6.20	8.18	9.23	7.83	7.60	7.16	5.69	4.52
Std. Dev.	1.84	2.89	3.25	3.88	4.46	2.61	3.04	3.77	3.15	2.81	3.39	2.04	1.22
PROLINE	18.77	19.74	21.32	24.95	25.16	27.03	28.68	26.37	27.03	25.53	21.95	19.34	18.65
Std. Dev.	6.83	5.16	3.29	6.06	5.39	4.55	5.01	7.81	5.53	6.96	5.38	3.96	3.23
CITRULLIN	2.90	2.85	2.62	2.45	2.34	1.99	2.46	2.83	2.91	3.26	2.87	2.91	2.51
Std. Dev.	1.22	1.16	0.97	0.65	0.97	0.96	1.05	0.74	1.36	1.55	1.10	0.94	0.91
GLYCINE	23.90	24.08	26.27	28.04	28.17	30.23	31.66	29.42	28.59	24.73	22.33	20.83	20.47
Std. Dev.	3.01	2.02	2.90	4.23	3.26	3.58	4.43	5.49	4.62	4.40	2.92	1.54	2.00
ALANINE	29.13	33.45	35.27	40.10	42.85	46.10	47.33	43.72	41.56	36.94	31.30	27.92	27.47
Std. Dev.	7.28	7.19	9.76	10.75	11.31	7.76	11.03	11.93	8.81	7.31	9.26	7.20	6.29
AMINOGB	1.76	2.04	2.07	2.19	2.36	2.42	2.47	2.45	2.80	3.05	3.09	3.11	2.87
Std. Dev.	0.63	1.02	1.00	1.00	1.20	1.12	1.32	1.09	0.81	1.56	1.64	1.76	1.78

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL ONLY

PLASMA AMINO ACIDS, DOSE =	0 0 SUBJECTS = 6												
	TIME (MIN)	0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.
VALINE	19.90	21.95	24.72	25.52	25.57	26.89	30.26	33.50	35.09	34.26	33.90	30.31	29.14
Std. Dev.	6.35	6.84	7.42	7.71	7.84	9.56	9.47	7.20	5.47	7.71	7.60	6.39	7.27
CYSTINE	8.25	9.17	9.61	9.71	9.50	9.76	10.07	9.40	8.81	9.10	8.09	7.77	7.88
Std. Dev.	1.34	1.76	2.35	1.97	2.11	2.66	2.70	2.88	2.04	2.19	1.64	1.56	1.49
METHION	2.93	3.22	3.84	4.14	4.49	5.07	5.88	6.46	6.23	5.95	4.93	4.06	3.38
Std. Dev.	0.34	0.46	0.62	0.80	0.93	0.41	0.85	0.46	0.79	1.02	1.34	1.13	0.67
ISOLEUCIN	7.49	8.03	9.69	10.37	10.76	10.58	12.76	14.66	15.34	16.98	14.76	12.35	10.87
Std. Dev.	2.69	1.80	2.31	2.32	2.63	2.50	3.50	2.10	3.74	2.89	2.35	3.37	2.92
LEUCINE	12.62	14.13	16.88	17.87	18.21	18.52	21.85	25.09	25.75	27.10	23.66	19.89	17.70
Std. Dev.	3.33	2.91	3.95	4.52	4.66	3.19	6.26	4.02	4.32	4.52	5.33	5.12	4.76
TYROSINE	4.96	5.34	6.36	6.64	6.74	7.24	8.21	8.76	9.31	9.03	7.70	6.59	5.97
Std. Dev.	1.09	3.94	1.42	1.56	1.52	1.16	2.62	2.29	2.26	1.85	0.93	1.31	1.27
PHENYLAL	4.72	5.04	5.80	5.90	5.93	6.24	6.81	6.82	7.14	7.12	5.99	5.30	5.11
Std. Dev.	0.52	0.46	0.63	0.70	0.64	0.47	1.46	1.28	0.82	0.98	0.53	0.63	0.55
GLUTAMIN	7.73	6.98	8.90	8.74	9.22	9.99	9.83	9.98	10.83	11.09	10.21	8.76	7.47
Std. Dev.	2.40	2.56	4.00	3.49	3.44	3.59	3.71	1.50	2.45	2.37	1.92	1.05	1.02
LYSINE	18.53	21.59	24.31	27.26	29.41	31.71	35.30	37.86	37.23	36.88	30.38	24.53	21.07
Std. Dev.	5.15	4.38	5.75	8.07	8.07	4.27	9.82	5.93	7.07	7.84	9.02	6.69	4.64
HISTIDIN	8.72	8.33	8.49	9.89	10.57	11.72	13.09	13.29	13.17	12.05	10.50	9.21	8.05
Std. Dev.	1.84	1.64	1.65	2.46	2.65	2.76	2.12	1.79	2.25	2.78	2.26	2.23	1.73
ARGININ	9.81	10.49	11.33	12.81	13.73	14.49	16.28	17.11	16.87	15.70	12.65	10.31	9.14
Std. Dev.	1.93	1.59	2.36	2.65	3.08	2.59	3.85	4.56	4.38	3.80	2.85	1.53	1.18

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

March 7, 1977

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS TAURINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
HALEY,	5.15	4.11	4.64	5.11	6.55	7.15	7.72	7.56	8.59	10.20	11.50	7.65
WUFLER,	4.98	3.97	3.76	3.79	4.39	4.52	5.49	4.97	4.73	3.86	3.46	3.48
MUMFEL,	5.55	4.25	4.63	5.08	6.09	6.55	6.82	6.37	5.19	5.36	4.99	4.46
SMITH, K	4.58	4.91	5.24	4.79	5.84	3.16	4.86	4.03	5.13	4.80	5.02	4.65
MERRYMAN	6.34	5.53	5.95	7.40	8.60	9.83	8.71	7.43	5.76	5.45	6.44	7.70
MUESSEG,	4.54	3.89	4.87	5.13	4.58	5.13	5.77	6.36	3.89	4.54	3.88	3.88
MEAN	5.19	4.44	4.85	5.22	6.01	6.89	7.24	6.58	5.55	5.70	5.88	5.30
STD. DEV	0.67	0.64	0.73	1.19	1.53	1.96	1.40	1.04	1.61	2.28	2.94	1.88
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μmoles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL • DOSE = 0 MG/KG

VARIABLE IS ASPART

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESIG.	0.15	0.23	0.19	0.34	0.24	0.11	0.50	0.49	0.46	0.55	0.31	0.32	0.29
MERRIMAN	0.43	0.44	0.59	0.71	0.81	0.83	1.18	0.93	1.05	1.05	0.82	0.66	0.84
SMITH, K	0.23	0.17	0.17	0.23	0.14	0.19	0.29	0.43	0.4	0.33	0.28	0.08	0.20
MUMMEL.	0.41	0.45	0.66	0.81	0.82	0.71	0.95	1.33	1.0	1.10	1.16	0.62	0.26
MUELLER.	0.51	0.40	0.40	0.37	0.42	0.45	0.52	0.94	0.6	0.85	0.59	0.47	0.30
MAULEY.	0.20	0.24	0.16	0.12	0.12	0.11	0.30	0.88	0.34	0.20	0.11	0.07	0.06
MEAN	0.32	0.32	0.36	0.43	0.42	0.40	0.44	0.83	0.74	0.68	0.54	0.37	0.32
STD. DEV	0.15	0.12	0.22	0.27	0.32	0.31	0.35	0.33	0.39	0.38	0.19	0.26	0.27
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL • DOSE = 0 MG/KG

VARIABLE IS THREON

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
HANLEY.	14.60	19.90	20.60	22.40	23.80	25.20	28.43	29.40	29.80	25.90	21.50	18.80	16.80
MUELLER.	18.52	18.34	18.92	21.49	20.77	21.40	22.22	27.93	27.72	28.96	23.97	19.61	18.10
MUMMEL.	14.84	16.64	18.72	20.18	21.23	20.77	24.02	22.92	22.04	20.52	21.83	19.76	15.95
SMITH, K	7.15	8.42	9.20	9.31	9.39	13.50	11.17	13.14	14.78	14.54	12.77	12.46	11.33
MERRIMAN	15.08	15.60	18.65	20.99	21.35	19.66	22.89	20.10	20.28	19.65	16.74	16.54	20.90
MUESIG.	14.90	15.12	17.68	19.11	17.94	18.94	21.46	21.50	20.04	19.83	16.65	14.22	13.76
MEAN	14.18	15.67	17.29	18.91	19.08	19.91	21.69	22.50	22.45	20.90	18.91	16.90	16.14
STD. DEV	3.75	3.97	4.08	4.84	5.10	3.82	5.71	5.86	5.50	5.62	4.20	3.04	3.34
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL • DOSE = 0 MG/KG

VARIABLE IS SERINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	11.71	11.94	13.69	15.58	14.25	14.72	15.64	14.85	14.21	11.73	9.57	10.29
MERRYMAN	10.97	11.70	14.14	15.31	15.21	13.67	12.67	12.48	12.16	11.12	11.00	13.11
SMITH, K	9.27	10.98	11.88	12.17	12.05	16.97	14.26	14.97	13.82	11.54	11.55	10.67
MUNNEL,	10.77	11.86	14.74	15.05	15.42	14.31	15.45	14.31	12.86	13.65	11.88	10.42
MUELLER,	8.24	7.69	8.09	13.71	9.45	9.11	11.83	12.25	11.44	8.41	7.15	8.00
MUNNEL,	11.70	17.40	21.30	24.90	22.80	19.80	18.90	24.90	20.03	17.00	15.80	15.30
MEAN	10.44	11.93	13.97	15.62	14.90	14.96	14.79	15.63	13.61	12.24	11.19	11.30
STD. DEV	1.40	3.13	4.32	4.95	4.50	3.92	2.51	4.69	3.26	2.87	2.80	2.54
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL • DOSE = 0 MG/KG

VARIABLE IS ASPARAGIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	7.95	7.20	7.69	6.50	7.50	7.89	10.95	9.64	9.88	7.71	5.53	4.81
MUNNEL,	6.79	5.05	4.14	7.65	7.91	8.95	6.13	8.50	5.27	5.61	5.24	4.30
MUNNEL,	6.56	6.30	7.01	7.38	6.38	8.28	6.30	9.21	9.64	5.95	4.61	4.14
SMITH, K	0.00000	3.18	5.74	5.19	4.99	5.63	6.71	5.84	5.07	3.67	5.05	4.68
MERRYMAN	0.00000	0.89	3.20	6.89	6.88	6.89	5.55	4.76	4.54	5.40	1.25	3.66
MUESSIG,	3.91	3.29	4.67	5.49	5.06	6.85	8.18	6.03	5.61	5.27	3.94	3.55
MEAN	5.80	4.32	5.41	6.52	6.45	7.55	7.30	7.33	6.67	5.80	4.24	4.19
STD. DEV	1.81	2.32	1.73	1.00	1.22	1.30	1.99	2.04	2.43	1.30	1.57	0.52
N	4.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

March 7, 1977

MEAL STUDIES
PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS GLUTAMIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	6 HR	5 HR	6 HR	7 HR	8 HR
MUESIG.	47.43	43.60	54.31	59.54	53.64	59.40	62.94	64.72	67.53	50.87	57.43	49.79	47.34
MERRYMAN	50.71	57.99	66.03	63.50	64.71	55.79	58.68	57.05	60.23	64.37	56.25	59.26	46.88
SMITH, R	54.44	55.15	55.05	48.70	55.20	74.85	56.09	53.97	60.41	47.57	53.03	50.00	44.16
MALEV.	61.30	56.10	66.10	64.10	72.40	77.40	78.30	61.20	72.80	67.70	59.50	54.60	50.90
MUMMEL.	52.91	66.64	69.02	72.65	72.52	72.33	89.74	80.92	85.22	84.65	90.05	84.84	69.82
MUELLER.	71.68	66.97	65.94	71.48	67.19	65.20	66.47	68.40	63.29	62.27	54.79	51.62	58.60
MEAN	60.08	57.74	62.74	63.33	64.28	67.49	68.70	64.38	68.25	62.90	61.84	58.33	52.93
S.D. DEV	7.97	8.65	6.36	8.74	8.22	8.76	12.30	9.61	9.59	13.25	14.00	11.45	9.66
	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS GLUTAMIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	6 HR	5 HR	6 HR	7 HR	8 HR
MUELLER.	4.99	7.14	6.69	7.26	7.08	6.81	6.94	10.53	8.51	7.94	7.69	6.72	6.71
MUMMEL.	6.32	9.49	9.79	13.01	13.00	8.17	11.64	15.79	11.01	11.32	12.29	7.76	4.71
MANLEY.	3.14	1.99	3.36	4.08	3.43	5.04	8.48	8.10	9.40	6.84	6.27	4.54	5.87
SMITH, R	1.39	2.51	2.55	3.97	3.47	4.96	5.01	5.82	4.63	4.52	3.17	3.43	5.45
MERRYMAN	5.38	6.88	9.09	10.45	11.63	9.76	11.84	9.53	10.17	10.26	9.38	7.97	2.67
MUESIG.	2.92	5.66	2.85	3.91	2.91	2.44	5.15	5.59	3.26	4.69	4.15	3.74	4.96
MEAN	4.02	5.61	5.72	7.11	6.92	6.20	8.18	9.23	7.83	7.60	7.16	5.69	4.52
S.D. DEV	1.84	2.89	3.25	3.88	4.46	2.61	3.04	3.77	3.15	2.81	3.39	2.04	1.22
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES 4 - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL . DOSE = 0 MG/KG

VARIABLE IS PROLINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	23.72	22.16	25.69	29.59	27.73	29.69	31.75	30.57	24.19	19.91	21.18	20.07	19.55
MERRYMAN	15.20	16.32	21.08	22.76	23.74	22.28	26.60	24.01	23.53	29.21	18.38	18.08	19.42
SMITH, R	11.01	15.57	16.09	17.03	17.50	24.65	20.86	21.52	23.06	21.00	17.64	17.65	16.67
HANLEY,	17.20	17.50	23.90	23.20	24.70	27.20	31.13	17.50	29.30	24.30	19.60	16.80	15.30
MUMMEL,	15.62	17.72	20.71	22.86	23.51	22.21	26.69	24.90	22.97	20.85	22.64	19.38	16.69
MUELLER,	29.87	29.18	20.47	34.27	33.81	34.14	35.08	39.70	37.16	37.91	32.29	27.66	24.30
MEAN	18.77	19.74	21.32	24.95	25.16	27.03	28.68	26.37	27.03	25.53	21.95	19.94	18.65
STD. DEV	6.83	5.16	3.29	6.06	5.39	4.55	5.01	7.81	5.53	6.96	5.38	3.96	3.23
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL . DOSE = 0 MG/KG

VARIABLE IS CITRULLIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	4.28	4.05	3.28	2.95	2.79	2.50	2.82	3.82	3.75	4.44	3.95	3.78	2.71
MUMMEL,	1.14	0.84	1.33	1.15	0.65	0.63	0.74	1.65	0.97	1.85	2.01	1.46	1.02
HANLEY,	4.21	3.19	3.56	2.71	3.37	3.31	3.92	3.19	4.36	4.38	3.74	3.68	3.58
SMITH, R	2.13	3.67	3.21	2.69	2.87	2.21	2.84	2.98	3.92	3.72	3.65	3.64	3.30
MERRYMAN	3.16	3.09	2.86	2.68	2.57	2.14	2.28	2.38	2.84	4.37	2.69	2.37	2.20
MUESSIG,	2.46	2.24	1.48	2.54	1.82	1.17	2.16	2.97	1.62	0.81	1.21	2.52	2.28
MEAN	2.90	2.85	2.62	2.45	2.34	1.99	2.46	2.83	2.91	3.26	2.87	2.91	2.51
STD. DEV	1.22	1.16	0.97	0.65	0.97	0.96	1.05	0.74	1.36	1.55	1.10	0.94	0.91
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS GLYCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	24.95	22.34	28.15	31.43	28.85	31.64	29.46	27.43	20.48	21.68	19.54	18.73
MERNYMAN	24.75	23.96	25.60	29.04	29.12	28.49	22.41	21.51	21.22	18.20	18.54	24.18
SMITH, K	19.71	22.37	22.68	20.40	22.44	26.38	25.88	27.71	23.02	20.12	20.80	18.99
MURPHY,	23.70	26.50	30.60	30.50	32.20	35.30	35.60	33.60	28.00	23.10	20.80	19.80
MUMFL,	21.79	22.66	23.79	25.95	27.06	32.19	27.04	27.43	23.75	25.26	22.96	20.00
MUELLER,	28.53	26.63	26.78	30.92	29.36	31.88	30.15	33.87	31.93	25.64	22.27	21.10
MEAN	23.90	24.08	26.27	28.04	28.17	31.66	29.42	28.59	24.73	22.33	20.83	20.47
STD. DEV	3.01	2.02	2.90	4.23	3.26	4.43	5.49	4.62	4.40	2.92	1.64	2.00
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS ALANINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	39.97	33.70	36.13	44.99	45.16	49.98	51.18	49.23	47.57	36.04	28.42	27.10
MUMFL,	31.20	30.17	34.66	38.99	42.62	54.12	40.51	45.17	41.66	44.32	40.30	34.52
MURPHY,	25.50	38.80	47.50	48.28	54.60	59.40	58.10	43.40	34.30	25.30	22.90	20.50
SMITH, K	16.42	17.61	18.69	19.26	21.95	28.56	26.86	31.04	25.83	22.62	21.56	19.48
MERNYMAN	33.41	28.75	32.70	42.05	45.76	40.80	34.10	30.31	36.00	21.99	22.76	32.45
MUESSIG,	35.68	33.65	41.93	47.13	45.22	51.10	51.58	50.23	36.31	37.53	31.57	30.76
MEAN	27.13	30.45	35.27	40.10	42.85	47.33	43.72	41.56	36.94	31.30	27.92	27.47
STD. DEV	7.28	7.19	9.76	10.75	11.31	11.03	11.93	8.81	7.31	9.26	7.20	6.29
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

March 7, 1977

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS A_AMINOAS

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	1.62	1.48	1.84	1.94	1.84	1.84	2.00	1.97	2.96	2.28	2.73	1.93	2.17
MERRYMAN	1.52	1.52	1.56	1.78	1.86	1.98	2.20	2.08	2.56	3.75	3.41	4.12	5.25
SMITH, K	0.70	0.90	0.95	0.94	1.02	1.24	0.78	1.10	1.64	0.97	1.02	1.30	1.41
HANLEY,	2.24	2.89	2.81	2.66	3.54	3.64	3.53	3.10	3.43	3.56	3.61	3.82	2.39
MUMMEL,	2.45	3.63	3.71	3.91	4.15	4.01	4.49	4.27	3.89	5.48	5.82	5.81	4.90
MUELLER,	2.02	1.81	1.58	1.92	1.78	1.81	1.82	2.19	2.30	2.28	1.98	1.70	1.09
MEAN	1.76	2.04	2.07	2.19	2.36	2.42	2.47	2.45	2.80	3.05	3.09	3.11	2.87
STD. DEV	0.63	1.02	1.00	1.00	1.20	1.12	1.32	1.09	0.81	1.56	1.64	1.76	1.78
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS VALINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	21.32	21.51	22.27	24.11	23.40	24.01	24.75	33.30	34.83	38.78	33.65	27.81	24.50
SMITH, K	9.92	11.43	12.14	12.70	12.92	18.57	15.15	21.04	25.84	28.82	26.47	25.76	22.52
MUMMEL,	28.09	32.60	34.09	34.31	37.37	34.89	43.04	42.42	40.90	45.65	48.56	42.94	35.92
HANLEY,	16.80	23.10	28.90	24.30	26.60	29.30	34.10	37.20	40.40	37.50	31.60	27.30	25.10
MERRYMAN	18.67	19.49	23.97	26.78	27.16	25.46	31.07	31.24	34.85	24.84	30.53	30.68	40.47
MUESSIG,	24.58	23.55	26.94	28.90	25.96	29.12	33.46	35.81	33.74	29.95	32.60	27.35	26.31
MEAN	19.90	21.95	24.72	25.52	25.57	26.89	30.26	33.50	35.09	34.26	33.90	30.31	29.14
STD. DEV	6.35	6.84	7.42	7.71	7.84	5.56	9.47	7.20	5.47	7.71	7.69	6.39	7.27
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS CYSTINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG.	9.73	9.87	10.06	10.74	9.34	9.30	10.13	8.84	8.19	7.05	7.48	6.73	8.19
MERRYMAN	7.44	7.47	8.17	8.50	8.04	7.43	8.59	6.75	6.72	11.02	6.45	6.79	8.44
MANLEY.	8.80	11.60	13.70	12.60	13.40	14.70	15.40	14.40	12.40	11.40	10.40	10.00	9.35
MUMFEL.	7.35	8.25	8.18	8.45	8.37	7.57	9.14	7.25	7.20	6.61	6.34	6.36	5.53
SMITH, K	6.51	7.32	7.19	7.26	7.21	10.27	8.07	8.06	8.79	7.74	7.11	7.29	6.64
MULLER.	9.68	10.54	10.39	10.69	9.87	9.28	9.11	11.04	9.57	10.76	9.94	9.47	9.11
MEAN	8.25	9.17	9.61	9.71	9.50	9.76	10.07	9.40	8.81	9.10	8.09	7.77	7.88
STD. DEV	1.34	1.76	2.35	1.97	2.11	2.66	2.70	2.88	2.04	2.19	1.64	1.54	1.49
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS METHION

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER.	3.25	3.23	3.75	4.48	4.78	5.04	5.11	7.00	7.11	6.98	6.27	4.11	3.00
SMITH, R	2.52	2.85	2.94	2.84	2.97	4.93	4.89	5.35	6.28	6.27	5.41	4.86	4.14
MUMFEL.	3.34	3.80	4.80	5.10	5.87	5.00	7.30	7.35	7.00	7.21	6.58	5.88	4.30
MANLEY.	2.87	3.57	3.51	3.60	4.43	5.47	6.01	6.78	6.11	5.41	3.89	3.28	3.00
MERRYMAN	2.50	2.56	3.97	4.31	4.42	4.42	5.98	5.42	4.92	5.18	3.34	3.24	3.12
MUESSIG.	3.10	3.34	4.05	4.51	4.49	5.54	5.98	6.87	5.99	6.68	4.09	2.99	2.72
MEAN	2.93	3.22	3.84	4.14	4.49	5.07	5.88	6.46	6.23	5.95	4.93	4.06	3.38
STD. DEV	0.36	0.46	0.62	0.80	0.93	0.41	0.85	0.86	0.79	1.02	1.34	1.13	0.67
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μmoles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS ISOLEUCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	9.17	9.75	11.09	11.59	11.10	12.83	14.48	15.48	10.55	13.00	14.01	10.43	9.74
GERRYMAN	6.98	7.74	10.72	12.71	12.64	11.60	15.45	16.00	17.76	18.03	14.79	14.13	14.70
HANLEY,	6.77	8.59	11.30	10.10	11.20	12.10	15.30	15.60	18.20	16.90	13.30	10.60	9.19
MUNNEL,	10.27	8.39	10.38	11.16	13.30	10.76	14.21	15.32	18.61	21.46	19.24	18.46	14.42
SMITH, R	2.74	4.64	5.15	5.99	5.85	5.80	6.60	10.41	10.72	14.91	12.61	9.79	8.03
MULLEN,	8.99	9.10	9.50	10.67	10.45	10.40	10.57	15.16	16.21	17.62	14.57	10.67	8.95
MEAN	7.49	8.03	9.49	10.37	10.76	10.58	12.76	14.66	15.34	16.98	14.76	12.35	10.81
STD. DEV	2.69	1.80	2.31	2.32	2.63	2.50	3.50	2.10	3.74	2.69	2.35	3.37	2.92
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS LEUCINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	13.76	14.19	13.39	17.16	16.63	16.73	17.03	24.43	25.85	28.07	22.71	16.84	14.90
SMITH, R	7.17	9.13	10.23	10.87	11.16	13.08	11.74	17.46	19.47	23.57	19.70	17.04	14.32
MUNNEL,	16.83	18.11	21.53	22.86	24.21	21.81	27.66	28.71	28.96	34.08	33.88	28.86	23.00
HANLEY,	10.70	13.70	16.80	15.40	17.20	18.70	23.70	25.90	28.30	25.50	19.40	16.30	13.60
GERRYMAN	13.14	14.43	20.01	22.62	22.58	20.59	27.39	27.77	30.24	29.76	24.23	23.32	24.48
MUESSIG,	14.15	15.24	17.31	18.12	17.51	20.19	23.55	26.27	21.66	21.60	22.04	16.96	15.92
MEAN	12.62	14.13	16.88	17.87	18.21	18.52	21.85	25.09	25.75	27.13	23.66	19.89	17.70
STD. DEV	3.33	2.91	3.95	4.52	4.66	3.19	6.26	4.02	4.32	4.52	5.33	5.12	4.76
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL . DOSE = 0 MG/KG

VARIABLE IS TYROSINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	6.27	5.90	6.72	7.19	6.74	8.74	9.00	8.41	7.04	7.27	5.71	5.41
MERRIMAN	5.94	6.24	8.07	8.69	8.77	10.51	10.50	11.31	11.04	8.32	7.74	8.48
HAWLEY,	4.68	5.96	7.56	7.17	7.79	11.40	12.20	12.90	11.50	8.67	6.89	5.65
MUMFORD,	4.55	5.15	6.07	6.54	6.86	8.19	7.80	8.25	8.92	8.59	7.65	5.95
SMITH, R	3.24	3.67	4.16	3.95	4.34	4.1	6.00	7.24	7.57	6.72	6.23	5.32
MUELLER,	5.10	5.10	5.57	6.33	5.95	5.68	7.07	7.78	8.10	6.65	5.30	5.00
MEAN	4.96	5.36	6.36	6.64	6.74	8.21	8.76	9.31	9.03	7.70	6.59	5.97
STD. DEV	1.09	0.94	1.42	1.56	1.52	2.62	2.29	2.26	1.85	0.93	1.01	1.27
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL . DOSE = 0 MG/KG

VARIABLE IS PHENYLAL

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	5.04	4.99	5.35	6.23	5.81	6.56	5.36	6.66	6.74	5.74	4.79	4.69
SMITH, R	3.78	4.41	4.86	4.62	4.86	5.44	6.21	7.11	7.20	6.04	5.65	5.18
MUMFORD,	5.07	5.75	6.56	6.73	6.79	7.75	6.73	6.82	7.11	6.88	6.40	5.44
HAWLEY,	4.65	5.34	6.28	5.80	6.34	8.13	9.00	8.72	7.89	6.22	5.09	4.65
MERRIMAN	4.57	4.75	6.07	6.08	5.88	7.24	6.11	6.41	8.29	5.31	5.16	6.00
MUESSIG,	5.18	5.00	5.68	5.96	5.88	7.74	7.50	7.11	5.48	5.74	4.72	4.67
MEAN	4.72	5.04	5.80	5.90	5.93	6.81	6.82	7.14	7.12	5.99	5.30	5.11
STD. DEV	0.52	0.46	0.63	0.70	0.64	1.46	1.28	0.82	0.98	0.53	0.63	0.55
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (umoles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS ORNITHIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG,	11.12	11.80	14.07	14.17	13.09	14.63	7.92	11.36	10.09	9.89	10.97	9.50	8.51
MERRIAM,	4.80	5.16	6.49	7.73	7.91	7.68	9.24	9.08	10.18	10.21	8.30	8.27	7.67
MAHLEY,	6.98	6.00	11.80	11.40	13.30	14.30	16.93	10.70	15.30	14.70	12.70	9.82	8.23
MUMFEL,	9.91	6.37	8.00	7.01	7.35	7.09	9.23	9.12	9.19	8.83	9.57	8.18	6.52
SMITH, K	5.86	4.88	4.13	4.34	4.50	6.79	6.01	7.90	8.46	9.41	7.94	7.17	5.92
MUELLER,	7.74	7.66	7.83	7.79	9.15	9.46	9.70	11.71	11.74	13.12	11.78	9.63	7.96
MEAN	7.73	6.98	8.90	8.74	9.22	9.99	9.83	9.98	10.83	11.09	10.21	8.76	7.47
STD. DEV	2.40	2.56	4.00	3.49	3.46	3.59	3.71	1.53	2.45	2.37	1.92	1.05	1.02
N	6.	6.	5.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS LYSINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	20.48	21.43	23.31	22.46	28.86	29.87	30.88	42.82	42.47	42.58	34.47	24.08	28.90
SMITH, K	10.93	15.20	15.72	16.16	17.16	27.23	24.79	30.47	31.11	32.52	24.81	21.34	17.97
MUMFEL,	26.25	28.73	8.00	37.20	39.30	37.96	49.51	46.38	47.47	47.81	46.99	37.70	30.09
MAHLEY,	16.00	21.80	26.70	26.80	30.70	34.30	39.83	38.10	38.10	36.80	25.10	19.90	17.20
MERRIAM	20.36	22.57	31.50	35.94	36.31	33.54	41.26	36.66	35.81	36.36	24.08	23.84	20.18
MUESSIG,	17.17	19.79	24.31	25.03	24.11	27.38	25.59	32.93	28.44	25.21	26.63	20.30	20.11
MEAN	18.53	21.59	24.31	27.26	29.41	31.71	35.30	37.86	37.23	36.88	30.38	24.53	21.07
STD. DEV	5.15	4.38	5.75	8.07	8.07	4.27	9.82	5.93	7.07	7.84	9.02	6.89	4.64
N	6.	6.	5.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL STUDIES - INDIVIDUAL DATA
 PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS HISTIDINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG, K	6.28	6.05	7.79	8.66	7.79	9.05	10.70	10.81	9.53	7.92	8.98	6.86	6.25
MURPHY, K	8.99	9.00	10.79	13.01	13.97	13.08	14.89	13.20	13.41	12.06	10.00	10.14	8.35
MARLEY, K	7.40	6.83	6.43	6.33	7.40	8.38	11.10	11.90	12.10	9.93	7.56	6.47	5.86
MUMFEL, K	11.82	9.89	9.31	12.35	12.95	12.23	16.16	14.64	16.24	15.44	13.84	12.45	10.52
SMITH, K	9.02	10.07	9.31	9.33	10.13	15.92	13.02	13.47	13.25	12.61	10.35	9.92	8.70
MUELLER, K	8.62	8.13	8.11	9.49	11.00	11.67	12.68	15.75	14.30	14.34	12.29	9.41	8.64
MEAN	8.72	8.33	8.49	9.89	10.57	11.72	13.09	13.29	13.17	12.05	10.50	9.21	8.05
STU. DEV	1.84	1.64	1.65	2.46	2.65	2.76	2.12	1.79	2.25	2.78	2.26	2.23	1.73
N	6.	6.	5.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL DOSE = 0 MG/KG

VARIABLE IS ARGININE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER, K	11.60	12.12	12.69	14.03	15.34	14.84	15.71	21.07	20.76	20.84	16.71	11.98	11.13
SMITH, K	7.83	8.20	7.74	7.81	8.64	12.82	11.34	12.93	13.43	13.31	10.34	9.48	7.37
MARLEY, K	8.56	12.50	11.30	14.00	17.40	19.80	23.10	24.40	23.70	19.33	12.80	10.10	9.78
MURPHY, K	9.43	10.2	14.05	18.42	15.20	13.78	16.76	14.01	14.45	12.70	9.47	8.75	8.76
MUESSIG, K	8.71	9.92	10.88	12.30	11.93	13.54	14.62	15.04	12.73	11.54	11.33	8.94	8.92
MUMFEL, K	12.74	9.93	9.99	13.31	13.87	13.37	16.17	15.20	15.95	16.50	15.26	12.64	9.69
MEAN	9.81	10.49	11.33	12.81	13.73	14.69	16.28	17.11	16.07	15.73	12.65	10.31	9.16
STU. DEV	1.93	1.59	2.36	2.65	3.08	2.59	3.85	4.56	4.38	3.80	2.85	1.43	1.18
N	6.	6.	5.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

 TABLE 3: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal containing protein at 1 gm/kg.

MEAL & MSG

PLASMA AMINO ACIDS, DOSE = 34 g SUBJECTS = 4	0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.	480.
TIME (MIN)													
TAURINE	4.22	4.06	4.81	5.09	5.55	6.33	5.78	5.22	5.25	4.22	3.89	4.38	4.00
Std. Dev.	0.82	1.05	1.17	1.05	1.41	1.70	1.26	1.04	0.89	0.68	0.59	0.80	0.76
ASPART	0.24	0.33	0.39	0.45	0.55	0.87	0.78	0.77	1.12	0.54	0.37	0.35	0.20
Std. Dev.	0.06	0.06	0.16	0.24	0.33	0.56	0.57	0.44	0.52	0.27	0.17	0.15	0.11
IMREON	14.88	17.59	19.79	20.40	23.49	25.39	24.42	25.46	28.12	21.84	18.82	19.85	18.96
Std. Dev.	6.24	3.49	5.46	6.13	8.97	7.74	6.45	8.17	9.40	7.68	6.89	8.26	7.32
SEBINE	11.47	13.31	15.02	14.87	17.20	18.48	17.12	17.04	18.00	13.76	11.87	12.55	12.32
Std. Dev.	3.78	6.63	4.23	4.36	5.20	6.23	5.10	5.39	5.69	4.68	4.28	4.28	4.23
ASPARAGN	4.59	5.38	6.27	7.07	7.43	8.67	7.52	8.21	8.37	5.98	4.54	5.10	4.74
Std. Dev.	2.08	1.40	1.61	1.84	2.17	2.66	2.21	3.04	2.70	2.24	2.97	2.49	2.53
GLUTAMIN	47.89	47.91	52.12	51.22	54.58	55.80	50.10	51.89	51.70	45.10	41.05	42.59	43.05
Std. Dev.	5.10	5.17	3.86	4.56	9.72	8.98	7.63	7.45	8.84	6.81	6.25	7.50	8.26
GLUTAMAT	3.42	5.62	6.31	6.68	7.52	8.75	8.24	7.26	9.57	6.09	4.79	4.70	4.11
Std. Dev.	0.74	2.02	3.18	4.47	5.30	4.95	4.76	4.16	4.31	2.53	1.83	2.15	1.62
PROLINE	18.60	21.17	24.66	24.78	27.28	30.62	29.48	28.22	31.47	23.73	19.84	19.96	19.74
Std. Dev.	4.22	5.26	4.49	4.73	5.44	7.16	5.25	6.29	5.48	4.00	3.13	3.60	3.75
CITRULLN	2.84	2.80	2.50	2.33	1.85	2.34	2.61	2.87	4.39	3.74	3.19	2.94	3.04
Std. Dev.	0.78	0.83	0.64	0.48	0.75	0.47	0.56	1.18	0.91	0.57	0.66	0.59	0.62
GLYCINE	24.03	23.52	26.47	26.96	30.62	33.25	31.26	31.59	31.51	23.10	19.89	21.53	21.14
Std. Dev.	7.30	4.97	5.44	5.67	7.66	8.89	7.46	7.60	7.53	6.23	5.38	5.97	5.43
ALANINE	29.83	32.76	38.86	41.75	47.99	51.73	46.22	47.09	45.37	33.00	26.40	28.38	27.55
Std. Dev.	8.78	6.76	9.76	11.07	15.25	16.53	11.74	10.36	11.44	7.22	6.32	5.50	4.60
A-AMINOB	2.05	1.98	2.15	2.15	2.27	2.26	2.23	2.26	2.55	2.29	2.75	2.46	2.51
Std. Dev.	0.97	0.74	0.77	0.73	0.74	0.66	0.66	0.69	0.73	0.63	1.94	0.63	0.80

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL C MSG

PLASMA AMINO ACIDS, DOSE = 34 g SUBJECTS = 6		0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.	480.
TIME (min)		0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.	480.
VALINE	Std. Dev.	22.52	22.19	24.82	24.95	27.99	31.29	30.52	34.22	35.94	34.40	29.42	30.59	28.38
		0.71	4.19	2.38	3.20	3.13	5.99	3.81	5.09	9.71	2.22	2.22	4.19	3.17
CYSTINE	Std. Dev.	9.41	10.55	10.63	10.37	11.17	11.18	10.42	10.44	10.57	8.77	8.27	9.38	8.93
		1.52	1.47	1.28	1.02	1.32	1.30	1.34	1.39	0.72	0.66	1.31	0.89	1.16
LEUCINE	Std. Dev.	3.70	4.23	4.98	5.26	6.30	7.73	7.57	8.21	9.48	6.88	5.19	4.83	4.52
		0.61	1.10	1.15	1.42	1.79	2.52	1.80	2.39	2.57	1.43	1.39	1.24	1.26
ISOLEUCINE	Std. Dev.	8.20	8.72	10.28	10.55	12.24	14.56	14.22	14.86	19.01	14.56	11.28	10.90	12.54
		2.88	2.04	1.49	1.66	2.81	3.70	2.57	3.94	4.02	1.78	1.77	2.43	2.53
LEUCINE	Std. Dev.	13.21	14.38	17.12	17.69	20.43	23.91	23.51	23.94	31.61	23.58	18.19	17.85	17.19
		4.11	2.72	1.98	3.77	4.64	6.32	4.92	7.63	6.93	2.28	2.03	3.26	3.24
LYSINE	Std. Dev.	5.94	6.47	7.20	7.29	8.22	9.68	9.52	10.12	12.33	9.75	7.79	7.92	7.24
		1.45	1.31	0.76	1.38	1.08	2.01	1.45	1.87	1.86	0.70	0.72	1.14	1.47
PROLINE	Std. Dev.	5.07	5.58	6.14	6.14	6.75	7.52	7.24	7.26	8.49	6.60	5.39	5.59	5.42
		1.04	0.99	0.90	1.27	0.73	1.31	0.93	1.12	1.14	0.79	0.76	1.16	0.90
ORNITHINE	Std. Dev.	5.11	5.61	6.55	6.99	7.45	8.63	8.80	9.19	10.42	9.24	7.94	7.93	7.39
		1.65	0.98	0.91	1.48	0.89	1.85	1.76	1.90	1.91	1.42	1.61	1.58	1.82
LYSINE	Std. Dev.	16.54	19.12	23.30	25.43	28.23	34.46	34.92	35.96	39.16	27.14	22.43	20.94	20.13
		3.99	2.06	3.24	6.94	5.18	6.24	3.02	4.41	5.07	6.30	7.03	6.34	4.43
METHIONINE	Std. Dev.	7.04	7.24	8.62	9.56	10.45	12.12	11.95	11.92	12.08	9.22	8.10	8.08	7.69
		1.67	0.74	0.43	1.60	1.00	2.41	2.58	2.83	3.29	3.02	2.89	2.91	2.20
ARGININE	Std. Dev.	9.69	11.03	13.36	14.21	16.04	19.12	19.47	19.70	21.34	15.57	11.67	11.07	10.44
		1.99	1.66	1.17	3.74	2.56	4.64	3.73	3.41	3.41	2.75	3.95	1.90	1.78

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

March 7, 1977

MEAL STUDIES
PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS TAURINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER, N	3.23	2.24	3.19	4.75	4.65	6.39	4.93	3.69	4.13	3.65	3.50	4.24	3.88
WYATT, M	4.13	3.71	3.53	3.79	3.62	4.28	4.21	5.21	5.42	4.74	3.83	5.19	3.83
WYATT, R	4.70	4.46	5.39	4.77	7.49	9.18	7.72	6.15	5.79	3.99	4.11	3.26	4.01
UNDERSON	4.71	4.41	5.55	6.79	6.76	6.56	5.93	5.37	5.49	4.85	4.39	4.88	4.14
WALKER, N	3.31	4.16	5.10	5.79	5.68	6.64	5.34	4.42	4.27	3.43	2.96	3.66	2.86
FLATTEM, N	5.27	5.41	5.72	4.63	5.08	4.95	6.66	6.48	6.42	5.18	4.53	5.06	5.24
MEAN	4.22	4.04	4.81	5.09	5.55	6.33	5.78	5.22	5.25	4.22	3.89	4.38	4.00
STD. DEV	0.82	1.05	1.17	1.05	1.41	1.70	1.26	1.04	0.89	0.68	0.59	0.80	0.76
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS ASPART

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WALKER, N	0.22	0.37	0.43	0.72	0.72	1.02	1.32	0.95	1.49	0.45	0.16	0.29	0.12
ANDERSON	0.32	0.37	0.60	0.73	0.99	0.97	1.13	1.21	1.73	0.81	0.37	0.58	0.30
FLATTEM, N	0.21	0.29	0.28	0.24	0.27	0.16	0.16	0.21	0.71	0.37	0.34	0.36	0.26
WYATT, R	0.25	0.41	0.50	0.49	0.77	1.67	1.36	1.25	1.24	0.62	0.49	0.41	0.14
WYATT, M	0.22	0.31	0.14	0.16	0.14	0.28	0.11	0.36	0.31	0.15	0.25	0.13	0.07
MUELLER, N	0.34	0.25	0.37	0.34	0.42	1.10	0.62	0.65	1.24	0.84	0.62	0.35	0.34
MEAN	0.26	0.33	0.39	0.45	0.55	0.87	0.78	0.77	1.12	0.54	0.37	0.35	0.20
STD. DEV	0.06	0.06	0.16	0.24	0.33	0.56	0.57	0.44	0.52	0.27	0.17	0.15	0.11
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels ($\mu\text{moles/dl}$) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS THREON

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
ANDERSON	16.09	16.43	19.38	20.87	23.82	23.98	22.74	24.51	27.56	19.85	16.53	17.05	16.17
AVATT, M	16.11	16.05	17.77	17.20	19.21	21.85	19.63	20.89	20.81	18.08	15.55	15.59	16.78
MULLER, R	28.10	24.61	30.61	32.35	41.08	39.56	36.72	41.37	46.32	37.24	32.73	36.25	33.28
WALKER, M	10.50	16.72	15.31	18.64	18.17	22.10	21.01	20.56	23.60	16.71	15.24	14.90	13.19
FLATTEM, M	20.04	15.08	17.96	15.29	16.90	17.20	20.38	19.57	22.11	18.56	15.06	20.13	19.51
AVATT, M	16.43	16.66	17.72	18.05	21.76	17.81	26.05	25.88	28.31	20.57	17.81	15.19	16.84
MEAN	16.88	17.59	19.79	20.40	23.49	25.39	24.42	25.46	28.12	21.86	18.82	19.85	18.96
STD. DEV	6.29	3.49	5.46	6.13	8.97	7.74	6.45	8.17	9.40	7.68	6.89	8.26	7.32
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS SERINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEM, M	12.54	10.38	12.77	10.61	13.33	12.73	14.04	13.85	13.91	10.90	8.65	12.62	12.52
WALKER, M	9.80	14.10	14.75	16.72	15.63	18.26	17.10	15.81	17.30	13.13	11.19	11.70	10.51
AVATT, M	12.08	15.27	15.34	15.09	18.51	23.14	20.46	20.39	20.47	14.27	12.76	11.36	11.78
WALKER, M	14.41	20.20	20.77	20.27	23.03	23.90	21.52	21.35	20.64	18.23	16.32	16.66	17.03
MULLER, R	15.21	13.46	18.01	17.68	22.72	23.54	21.12	22.43	25.94	19.34	16.60	17.78	16.52
ANDERSON	6.81	6.47	8.51	8.84	10.00	9.30	8.51	8.40	9.73	6.73	5.72	5.81	5.56
MEAN	11.47	13.31	15.02	14.87	17.20	18.48	17.12	17.04	18.00	13.76	11.87	12.65	12.32
STD. DEV	3.78	4.63	4.23	4.36	5.20	6.23	5.10	5.39	5.69	4.68	4.28	4.28	4.23
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal 1 gm/kg containing added MSG (34 mg/kg).

March 7, 1977

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS ASPARAGIN

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER, N	7.27	5.65	8.40	9.89	11.14	13.49	10.56	13.58	13.48	10.34	10.38	9.22	8.59
FLATTEN, R	6.93	6.77	7.49	7.70	8.70	6.57	9.52	10.00	8.81	5.98	3.55	7.03	6.51
WALKER, R	3.30	4.70	6.50	7.63	6.46	7.66	7.12	5.67	6.61	4.77	2.34	4.09	2.69
ANDERSON, N	2.21	3.47	4.88	4.75	5.01	6.39	4.85	6.56	6.33	4.14	2.64	2.98	1.78
AVATT, N	4.49	4.55	6.30	7.11	6.75	8.13	5.55	7.29	6.67	5.67	4.51	4.10	5.13
AVATT, R	3.34	7.13	4.05	5.36	6.53	9.80	7.54	6.19	8.31	4.96	3.83	3.17	3.77
MEAN	4.59	5.38	6.27	7.07	7.43	8.67	7.52	8.21	8.37	5.98	4.54	5.10	4.74
STD. DEV	2.08	1.40	1.61	1.84	2.17	2.66	2.21	3.04	2.70	2.26	2.97	2.49	2.53
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS GLUTAMIN

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
AVATT, N	50.50	52.51	57.27	58.74	62.96	64.36	56.83	55.13	54.84	49.12	41.93	44.09	52.59
AVATT, R	48.16	49.32	52.24	51.14	57.07	62.76	53.06	51.83	53.03	40.88	39.03	35.01	37.77
J. JENSON	43.27	41.62	45.84	45.76	43.44	42.26	37.06	39.35	39.83	33.93	30.85	34.72	33.38
WALKER, R	43.59	53.24	54.80	52.15	48.18	55.10	47.00	52.85	55.03	48.57	46.45	41.22	36.02
MUELLER, N	56.09	41.52	51.11	52.26	68.14	62.12	57.60	62.14	64.20	52.90	48.48	54.76	50.12
FLATTEN, R	50.73	49.24	51.48	47.27	47.70	48.23	49.07	50.04	43.29	45.21	39.56	45.75	48.43
MEAN	47.89	47.91	52.12	51.22	54.58	55.80	50.10	51.89	51.70	45.13	41.05	42.59	43.05
STD. DEV	5.10	5.17	3.86	4.56	9.72	8.98	7.63	7.45	8.84	6.81	6.25	7.50	8.26
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 mg/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS GLUTAMATE

SUBJECT / TIME	5 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEN, M	2.98	2.50	2.75	2.24	2.31	1.52	2.09	2.12	4.93	2.95	2.90	2.64	2.60
MULLER, M	2.31	4.20	6.54	3.78	4.19	10.03	8.56	5.34	9.96	5.20	4.85	4.41	4.61
WALKER, M	3.83	6.58	6.86	10.06	9.23	11.81	11.43	9.27	11.81	6.84	3.22	4.03	3.44
WATTS, R	3.27	7.95	8.33	8.87	11.92	13.04	12.76	11.65	10.69	8.14	7.12	6.28	5.53
WATSON, M	4.46	7.13	10.78	12.76	14.94	12.51	11.92	11.66	15.69	9.52	6.84	8.16	6.27
WATTS, M	3.65	5.37	2.62	2.35	2.52	3.59	2.66	3.55	4.33	3.88	3.78	2.71	2.44
MEAN	3.42	5.62	6.31	6.68	7.52	8.75	8.24	7.26	9.57	6.09	4.79	4.70	4.11
STD. DEV	0.74	2.02	3.18	4.47	5.30	4.95	4.76	4.16	4.31	2.53	1.83	2.15	1.62
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS PROLINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
ANDERSON	13.38	23.51	28.01	29.31	32.48	32.63	30.52	32.82	36.42	26.88	22.38	22.76	21.90
WATTS, M	17.42	23.14	24.64	23.92	27.03	30.00	28.55	22.58	27.91	23.09	19.79	16.69	22.40
MULLER, M	14.17	12.86	18.31	17.76	21.24	24.39	22.28	21.21	25.21	17.97	15.69	16.58	15.58
WATTS, R	21.41	28.43	30.86	30.36	35.08	43.29	38.52	37.92	39.59	28.45	24.17	21.23	21.69
FLATTEN, M	24.97	20.50	24.79	21.71	23.34	23.38	28.80	27.95	30.94	25.58	19.77	25.12	24.14
WALKER, M	14.06	18.60	21.35	25.60	24.49	30.04	28.21	26.86	28.75	20.44	17.25	17.40	14.76
MEAN	18.60	21.17	24.66	24.78	27.28	30.62	29.68	28.22	31.47	23.73	19.84	19.96	19.74
STD. DEV	4.22	5.26	4.49	4.73	5.44	7.16	5.25	6.29	5.48	4.00	3.13	3.60	3.75
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS CITRULLIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
BALDER, R	2.25	2.75	2.15	2.24	1.07	2.47	2.57	3.77	4.94	3.87	2.76	2.79	2.25
MUELLER, R	2.37	1.89	1.73	1.80	1.04	1.96	2.28	1.69	3.76	2.95	2.61	3.05	2.80
WYATT, R	3.85	4.19	3.07	2.81	2.81	2.71	3.49	4.28	5.47	4.46	4.14	3.87	3.29
FLATTEN, M	3.05	2.65	3.29	2.70	2.63	2.19	2.48	2.17	2.99	3.18	2.70	3.13	2.75
WYATT, M	3.60	3.24	2.81	2.70	1.88	2.97	2.96	1.60	4.22	4.10	3.90	2.06	4.09
ANDERSON, M	1.94	2.11	1.98	1.73	1.68	1.72	1.87	3.72	4.95	3.89	3.03	2.73	3.08
MEAN	2.64	2.60	2.50	2.33	1.85	2.34	2.61	2.87	4.39	3.76	3.19	2.94	3.04
STD. DEV	0.78	0.83	0.64	0.48	0.75	0.47	0.56	1.18	0.91	0.57	0.66	0.59	0.62
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS GLYCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEN, M	21.10	22.44	25.43	21.56	23.77	24.01	27.59	27.70	24.09	19.60	14.13	19.80	19.39
ANDERSON, M	17.47	18.37	21.70	22.73	25.91	25.48	24.39	25.88	26.50	17.50	16.75	16.26	17.37
BALDER, R	18.12	22.06	22.96	26.67	24.97	28.18	24.31	24.33	25.71	19.35	17.29	18.40	16.38
WYATT, M	35.08	33.01	36.20	36.37	39.91	46.37	42.84	42.56	40.15	33.43	28.34	30.77	30.30
MUELLER, R	31.10	23.61	29.19	30.74	40.68	40.09	37.17	38.78	41.62	28.02	24.51	27.08	25.11
WYATT, R	21.30	21.61	23.37	23.67	28.49	35.35	31.29	30.31	30.41	20.72	18.33	16.90	18.30
MEAN	24.03	23.52	26.47	26.96	30.62	33.25	31.26	31.59	31.51	23.18	19.89	21.53	21.14
STD. DEV	7.30	4.97	5.44	5.67	7.66	8.89	7.46	7.40	7.53	6.23	5.38	5.97	5.43
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (umoles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS ALANINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WALKER, R	37.41	40.98	48.77	51.51	62.02	75.73	62.80	58.99	58.82	38.08	30.67	26.31	29.39
FLATTEN, R	23.86	25.07	29.80	26.00	29.35	30.82	36.04	35.89	31.75	27.97	19.24	24.13	22.50
WALKER, R	22.50	27.18	31.25	38.50	37.80	42.45	36.14	39.20	35.70	25.40	23.55	26.29	22.50
WYATT, M	21.92	24.56	31.50	33.17	39.34	47.47	40.96	41.87	40.65	30.81	23.15	25.76	29.13
ANDERSON	30.16	29.74	39.44	46.97	50.64	47.09	42.28	46.08	46.93	30.82	24.92	26.63	27.12
WALKER, R	43.11	37.05	52.42	54.34	68.79	66.81	59.09	60.49	59.38	44.73	36.87	39.16	34.68
MEAN	29.83	30.76	38.86	41.75	47.99	51.73	46.22	47.09	45.37	33.03	26.40	28.08	27.55
STD. DEV	8.78	6.76	9.76	11.07	15.25	16.53	11.74	10.36	11.44	7.22	6.32	5.60	4.60
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS ALANINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WALKER, R	1.50	1.63	1.70	1.73	1.72	1.68	1.73	1.87	2.60	2.39	2.22	2.48	2.34
MUELLER, R	0.96	0.85	1.10	1.03	1.29	1.32	1.39	1.49	1.91	1.67	1.54	2.26	2.27
WYATT, M	2.05	2.24	2.17	2.48	2.57	2.74	2.47	2.11	2.52	2.14	2.18	1.80	1.88
FLATTEN, R	3.82	3.00	3.37	2.92	3.24	2.93	3.16	3.13	2.74	2.51	2.05	2.96	3.19
ANDERSON	2.13	2.38	2.57	2.82	2.85	2.76	2.71	3.11	3.78	3.35	6.69	3.42	3.73
WYATT, M	1.85	1.79	2.02	1.90	1.97	2.13	1.95	1.86	1.73	1.68	1.84	1.87	1.65
MEAN	2.05	1.98	2.15	2.15	2.27	2.26	2.23	2.26	2.55	2.29	2.75	2.46	2.51
STD. DEV	0.97	0.74	0.77	0.73	0.74	0.66	0.66	0.69	0.73	0.63	1.94	0.63	0.80
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

PEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS VALINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WYATT, N	23.13	23.65	24.19	23.05	25.02	27.80	26.06	30.01	31.56	32.45	29.07	28.12	33.80
FLATTEM,	39.55	23.97	27.16	23.05	24.58	23.67	28.60	27.43	34.71	34.31	29.74	38.23	27.23
ANDERSON	15.89	20.76	24.51	27.32	30.59	31.52	30.94	36.54	44.39	35.11	28.76	30.55	26.44
WYATT, R	23.61	28.27	27.66	27.06	32.38	40.48	35.14	41.01	19.39	38.16	33.52	28.03	28.64
MUELLER,	17.10	15.76	21.07	20.52	26.60	28.76	27.55	32.66	40.37	32.33	28.58	32.31	29.55
WALKER,	17.86	20.75	24.33	28.72	28.76	35.53	34.06	37.68	45.20	33.85	26.88	26.88	24.61
MEAN	22.52	22.19	24.82	24.95	27.99	31.29	30.52	34.22	35.94	34.40	29.42	30.49	28.38
STD. DEV	8.71	4.19	2.38	3.20	3.13	5.99	3.81	5.09	9.71	2.22	2.22	4.19	3.17
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS CYSTINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	9.85	8.60	10.10	9.07	11.79	10.57	10.07	11.14	10.73	8.76	7.58	8.86	8.77
WALKER,	6.98	9.15	8.39	9.61	8.71	9.76	8.48	8.85	9.49	8.07	6.62	7.56	6.86
WYATT, R	13.54	12.61	11.17	10.44	12.25	13.22	12.34	11.61	11.63	9.53	9.45	9.82	9.51
WYATT, N	10.21	10.82	10.70	10.69	11.50	12.29	11.53	11.83	10.63	9.46	9.21	9.85	8.63
ANDERSON	8.81	10.75	11.33	12.05	12.09	10.80	9.74	8.61	10.14	7.96	9.62	8.74	9.65
FLATTEM,	11.25	11.39	12.10	10.36	10.71	10.45	10.36	10.59	10.83	8.87	7.16	9.66	10.14
MEAN	9.61	10.55	10.63	10.37	11.17	11.18	10.42	10.44	10.37	8.77	8.27	9.08	8.93
STD. DEV	1.52	1.47	1.28	1.02	1.32	1.30	1.36	1.39	0.72	0.66	1.31	0.89	1.16
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 mg/kg) containing added MSG (34 mg/kg).

March 7, 1977

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS METHION

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEN.	2.80	2.29	2.91	2.58	3.03	2.81	4.14	3.71	4.99	4.37	2.91	3.61	3.09
ANDERSON	3.51	4.67	5.65	6.29	8.42	9.01	8.53	10.07	11.63	8.07	5.59	5.09	4.50
WYATT, N	4.31	5.60	5.81	5.92	6.20	7.95	7.48	7.96	8.09	7.25	5.41	5.11	6.06
MUELLER.	4.37	4.08	5.54	5.41	7.19	8.14	7.58	8.46	10.35	8.12	7.14	7.03	5.96
WALTON.	3.31	4.09	4.33	6.37	6.59	8.53	8.50	8.70	10.06	4.08	4.59	3.89	3.34
WYATT, R	3.88	4.66	5.66	4.97	6.36	9.95	9.22	10.35	11.74	7.39	5.48	4.23	4.18
MEAN	3.70	4.23	4.98	5.26	6.30	7.73	7.57	8.21	9.48	6.88	5.19	4.83	4.52
STD. DEV	0.61	1.10	1.15	1.42	1.79	2.52	1.80	2.39	2.57	1.43	1.39	1.24	1.26
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS ISOLEUC

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WALKER.	4.28	6.15	7.95	10.61	10.92	15.52	15.15	15.66	19.46	11.71	7.94	7.27	6.66
WYATT, R	8.74	10.78	11.20	11.05	14.32	18.97	17.43	19.71	23.42	16.38	12.36	9.47	9.45
ANDERSON	6.95	9.18	11.81	13.12	15.83	16.91	16.40	19.03	22.87	16.46	11.23	12.07	9.74
WYATT, N	8.62	11.27	11.45	10.68	11.67	12.92	11.96	12.90	14.17	14.53	11.83	10.00	13.39
MUELLER.	7.58	7.29	10.05	9.82	12.90	14.78	13.61	11.78	19.82	14.64	13.03	12.77	10.80
FLATTEN.	13.06	7.63	9.24	8.01	7.80	8.24	10.80	10.09	14.32	13.65	11.30	13.84	13.18
MEAN	8.20	8.72	10.28	10.55	12.24	14.56	14.22	14.86	19.01	14.55	11.28	10.90	10.54
STD. DEV	2.88	2.06	1.49	1.66	2.81	3.70	2.57	3.94	4.02	1.78	1.77	2.43	2.53
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS LEUCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	5 HR	7 HR	8 HR
FLATTEM, N	21.15	12.73	15.17	13.22	14.02	13.86	18.02	16.89	23.87	22.38	18.02	22.12	21.09
MULLER, R	10.43	10.52	15.46	14.68	19.60	23.28	21.29	14.88	32.54	23.62	20.54	19.99	17.01
WATKINS, R	13.03	12.97	16.01	20.54	20.76	26.88	27.42	28.30	34.20	20.72	14.50	13.99	12.59
WATKINS, R	12.56	17.25	17.57	16.53	17.66	19.76	18.16	19.91	22.51	22.37	18.04	15.68	20.68
WATKINS, R	13.58	17.09	18.18	17.76	22.86	30.80	28.04	31.62	37.48	25.45	19.29	15.35	15.42
WATKINS, R	11.49	15.73	20.36	23.39	27.66	28.88	28.13	32.02	39.06	26.95	18.74	19.99	16.38
MEAN	13.21	14.38	17.12	17.69	20.43	23.91	23.51	23.94	31.61	23.58	18.19	17.85	17.19
STD. DEV	4.11	2.72	1.98	3.77	4.64	6.32	4.92	7.63	6.93	2.28	2.03	3.26	3.24
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS TYROSINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEM, N	6.13	7.78	7.98	7.87	8.53	9.96	9.13	10.44	11.04	10.52	8.93	8.94	9.55
MULLER, R	6.10	7.25	7.80	8.32	9.37	9.62	9.30	9.89	13.02	9.32	6.79	7.32	6.25
WATKINS, R	5.23	6.79	7.07	7.00	8.35	11.66	11.04	11.72	14.07	10.01	7.59	6.22	6.05
WATKINS, R	5.41	6.83	7.42	9.06	9.09	11.54	11.39	12.62	14.39	10.44	8.15	7.87	6.61
FLATTEM, N	8.58	6.12	7.07	5.94	6.44	6.17	7.58	7.16	9.56	9.46	7.82	9.41	8.62
MULLER, R	6.30	4.05	5.85	5.53	7.56	9.11	8.67	10.08	11.89	8.74	7.47	7.75	6.38
MEAN	5.96	6.47	7.20	7.29	8.22	9.68	9.52	10.32	12.33	9.75	7.79	7.92	7.24
STD. DEV	1.45	1.31	0.76	1.38	1.08	2.01	1.45	1.87	1.86	0.70	0.72	1.14	1.47
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 mg/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS PHENYLAL

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER, M	4.26	3.85	5.10	4.86	6.41	6.97	6.52	7.14	8.64	6.38	5.83	5.70	5.02
FLATTEM, M	6.99	5.86	6.70	5.67	6.10	6.02	7.14	6.93	7.99	7.32	5.78	7.22	6.81
WALKER, R	5.39	6.77	7.53	8.42	8.10	9.66	8.85	9.30	10.59	7.58	6.07	6.19	5.75
ANDERSON, M	4.58	5.60	5.63	6.02	6.64	6.51	6.20	6.38	8.16	5.59	6.47	6.62	4.32
WYATT, M	6.98	6.15	6.35	6.61	6.90	7.83	7.22	7.60	7.19	6.82	5.80	5.87	5.89
WYATT, R	6.25	5.26	5.52	5.27	6.13	8.15	7.53	6.19	8.37	5.90	4.37	3.94	4.74
MEAN	5.07	5.58	6.14	6.14	6.79	7.52	7.24	7.26	8.49	6.63	5.39	5.59	5.42
ST.D. DEV	1.04	0.99	0.90	1.27	0.73	1.31	0.93	1.12	1.14	0.79	0.76	1.16	0.96
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS ORNITHINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WYATT, M	6.60	7.37	8.09	7.88	8.60	9.87	9.67	11.22	10.53	11.20	9.53	9.02	8.59
MUELLER, M	3.31	4.83	6.15	6.33	6.96	8.18	8.57	9.10	11.70	10.20	9.66	9.91	9.83
ANDERSON, M	3.84	4.71	5.98	6.79	7.43	7.68	7.22	8.03	9.68	8.01	5.87	6.78	5.31
WYATT, R	4.14	5.83	6.22	6.51	8.34	10.17	9.32	9.43	10.13	8.64	6.66	5.78	5.89
ANDERSON, M	5.31	5.78	7.21	9.39	8.24	10.29	11.44	11.14	13.66	9.91	8.85	7.20	6.24
FLATTEM, M	7.47	5.16	5.68	5.06	6.34	5.58	6.58	6.24	8.03	7.49	7.07	8.91	8.50
MEAN	5.11	5.61	6.55	6.99	7.65	8.63	8.80	9.19	10.62	9.24	7.94	7.93	7.3
ST.D. DEV	1.65	0.98	0.91	1.48	0.89	1.85	1.76	1.90	1.91	1.42	1.61	1.58	1.0
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

March 7, 1977

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS LYSINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WALKER, M	18.19	21.02	26.83	36.67	32.90	41.05	39.03	38.55	41.13	24.04	20.58	17.98	15.48
MUELLER, M	13.26	16.88	21.92	22.42	25.68	35.01	36.05	40.24	47.77	39.76	36.25	31.09	26.44
WYATT, M	12.45	16.70	18.19	18.88	26.26	35.76	34.85	34.55	36.16	23.17	16.80	13.47	15.56
ANDERSON, M	14.49	19.51	26.14	30.67	35.86	37.34	35.46	37.51	40.29	23.95	19.15	18.82	18.17
FLATTEH, M	23.15	19.91	22.00	19.62	21.72	22.59	29.75	27.80	33.74	26.59	19.24	24.41	22.64
WYATT, M	17.70	21.68	26.75	24.32	26.97	35.02	34.36	37.09	35.87	25.32	22.58	19.70	22.50
MEAN	16.54	19.12	23.30	25.43	28.23	34.46	34.92	35.96	39.16	27.14	22.43	20.94	20.13
STD. DEV	5.99	2.06	3.24	6.94	5.18	6.24	3.02	4.41	5.07	6.30	7.03	6.04	4.43
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL MSG. DOSE = 34 MG/KG

VARIABLE IS HISTIDINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
FLATTEH, M	12.03	8.28	8.78	8.14	8.95	8.90	11.01	10.46	11.02	8.09	6.62	8.87	8.91
WALKER, M	7.53	7.62	9.07	12.31	10.39	11.46	9.87	9.82	10.12	7.45	7.26	6.79	6.41
WYATT, M	6.74	6.94	8.85	9.18	9.83	12.44	12.03	12.49	11.97	9.16	7.74	8.86	6.72
ANDERSON, M	5.97	6.43	8.50	10.07	11.07	10.60	9.54	10.48	11.38	8.24	8.32	6.33	6.69
MUELLER, M	6.80	7.66	8.69	9.74	11.83	15.88	16.41	17.39	18.54	15.06	13.56	13.02	11.63
WYATT, M	5.19	6.49	7.84	7.91	10.66	13.45	12.65	10.66	9.43	6.53	5.11	4.61	5.81
MEAN	7.04	7.24	8.62	9.56	10.45	12.12	11.95	11.92	12.08	9.22	8.10	8.08	7.69
STD. DEV	1.67	0.74	0.43	1.60	1.00	2.41	2.58	2.83	3.29	3.02	2.89	2.91	2.20
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL MSG, DOSE = 34 MG/KG

VARIABLE IS ARGININ

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
WYATT, R	10.35	13.15	13.49	13.78	18.80	24.80	25.08	23.03	24.50	16.06	11.95	10.16	11.53
ANDERSON	6.34	8.77	11.84	13.88	16.45	17.10	16.38	17.76	19.08	11.65	6.96	8.74	8.56
WALKER, N	9.67	11.67	14.99	21.36	18.72	23.20	22.35	23.23	24.76	15.13	*****	10.05	7.94
WYATT, N	10.66	12.42	14.33	13.46	15.19	18.98	18.82	19.96	19.62	17.96	12.85	11.30	12.42
MUELLER, N	9.89	10.15	13.09	12.45	15.06	18.94	19.16	20.04	23.58	19.07	17.38	14.22	10.86
FLATTEN, N	12.24	10.01	12.45	10.36	12.02	11.73	15.01	14.17	16.49	13.54	9.20	11.96	11.36
MEAN	9.69	11.03	13.36	14.21	16.04	19.12	19.47	19.70	21.34	15.57	11.67	11.07	10.44
STD. DEV	1.99	1.66	1.17	3.74	2.56	4.64	3.73	3.41	3.41	2.75	3.95	1.90	1.78
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	5.	6.	6.

TABLE 4: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg).

MEAL & MSG & APM

PLASMA AMINO ACIDS, DOSE = 34 g SUBJECTS = 6	TIME (MIN)												
	0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.	480.
TAURINE	5.01	5.13	5.61	5.83	6.27	6.91	7.76	7.17	6.45	5.91	5.25	5.17	4.75
Std. Dev.	1.11	0.43	0.59	0.76	0.61	0.73	1.51	1.42	1.25	1.49	0.61	0.63	0.66
ASPART	0.26	3.29	0.34	0.38	0.40	0.54	0.72	0.86	1.14	0.84	0.61	0.37	0.22
Std. Dev.	0.11	0.24	0.29	0.34	0.33	0.37	0.48	0.49	0.69	0.37	0.29	0.18	0.17
IMREON	13.22	14.53	16.55	17.60	17.76	19.45	19.46	20.78	20.07	20.26	20.37	16.60	14.14
Std. Dev.	3.29	2.58	3.07	3.38	4.36	4.93	3.28	3.76	6.92	4.40	5.60	3.67	2.89
SERINE	11.48	13.13	14.02	15.58	15.23	16.40	16.19	17.02	17.29	16.06	14.98	13.48	12.00
Std. Dev.	2.46	2.01	1.94	2.90	2.95	4.06	2.76	3.63	5.11	4.91	4.52	3.32	2.17
ASPARAG	4.03	5.24	6.49	6.30	6.51	7.45	8.06	7.17	7.11	6.44	5.39	4.21	4.55
Std. Dev.	2.35	1.59	2.19	2.81	2.29	1.31	1.40	1.74	1.55	2.87	2.30	1.38	1.71
GLUTAMIN	53.96	52.03	57.41	58.65	56.67	56.78	55.99	56.31	56.65	52.71	54.60	51.50	50.16
Std. Dev.	13.79	9.79	10.30	12.30	12.19	12.18	7.96	10.78	10.20	10.68	11.26	12.15	12.91
GLUTAMAT	4.70	5.81	7.28	7.38	7.01	8.82	10.59	9.65	11.07	9.65	8.63	6.60	4.92
Std. Dev.	2.94	3.56	4.38	3.52	2.89	3.40	3.44	2.52	2.91	3.21	4.43	3.01	2.94
PROLINE	18.35	20.87	22.48	24.63	24.86	27.58	27.98	27.87	27.89	23.44	23.14	20.55	13.92
Std. Dev.	4.92	6.79	5.92	6.56	5.22	5.95	3.38	5.53	4.93	5.36	4.71	5.17	6.45
CITRULLIN	2.76	2.76	2.49	2.27	1.63	1.89	2.22	3.01	3.50	3.66	3.51	3.25	2.62
Std. Dev.	0.93	0.95	0.82	0.68	0.93	0.68	0.66	1.10	1.61	1.51	1.44	1.52	1.21
GLYCINE	22.91	24.08	26.16	27.46	26.84	28.18	27.22	26.91	26.02	22.98	22.46	20.97	19.38
Std. Dev.	5.22	6.07	5.82	7.01	6.37	8.30	5.95	4.00	6.74	7.23	5.69	4.59	3.81
ALANINE	28.59	31.91	38.31	41.51	42.05	43.80	40.45	39.99	37.39	31.81	30.75	27.02	25.12
Std. Dev.	7.24	6.50	10.23	8.10	8.75	9.74	6.85	8.16	7.05	7.63	6.15	3.53	2.48
AMINOAC	1.99	2.30	2.36	2.36	2.31	2.43	2.50	2.90	3.07	3.34	3.58	3.48	3.15
Std. Dev.	1.06	1.08	1.09	1.04	1.03	1.11	1.14	1.38	1.47	1.50	1.58	1.44	1.13

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

MEAL 6 MSG 6 APM

PLASMA AMINO ACIDS, DOSE = 34 SUBJECTS = 6	TIME (MIN)												
	0.	15.	30.	45.	60.	90.	120.	180.	240.	300.	360.	420.	480.
VALINE	20.56	22.50	26.04	24.02	25.73	28.28	30.78	34.51	38.72	40.00	39.05	33.14	29.29
Std. Dev.	8.46	7.35	10.15	7.90	7.48	8.31	9.33	10.04	9.07	7.51	8.45	7.12	5.70
CYSTINE	8.68	9.51	9.96	9.86	9.60	9.44	9.37	9.63	9.77	8.80	9.25	8.92	8.65
Std. Dev.	1.22	1.76	2.02	1.46	2.05	1.87	1.53	2.46	2.55	2.18	2.20	2.04	1.94
METHION	2.87	3.36	3.94	4.44	4.51	5.13	5.75	5.92	5.86	6.03	4.93	3.64	3.13
Std. Dev.	0.49	0.40	0.74	0.54	0.60	0.61	0.33	1.42	1.36	1.31	1.27	0.87	0.48
ISOLEUCIN	6.44	7.96	8.89	9.75	10.11	11.56	12.86	14.46	18.34	18.14	16.51	12.15	12.43
Std. Dev.	2.15	1.74	3.75	2.08	2.17	2.80	3.01	3.85	4.20	2.98	3.39	2.65	1.95
LEUCINE	12.48	14.86	17.61	18.08	18.29	20.44	22.47	26.45	29.45	30.16	27.03	20.53	17.63
Std. Dev.	4.31	3.60	6.50	4.26	4.67	5.84	6.24	7.50	8.91	5.36	5.78	4.33	3.44
TYROSINE	5.26	6.38	7.73	7.99	8.12	8.95	9.69	10.65	11.46	10.52	9.45	7.55	6.57
Std. Dev.	1.16	1.21	2.15	1.48	1.58	1.35	1.32	2.08	2.30	1.49	1.01	0.76	3.76
PHENYLAL	4.84	7.48	8.33	8.31	8.13	8.52	8.77	9.01	9.34	7.89	7.26	5.98	5.47
Std. Dev.	0.67	1.19	1.30	0.92	0.46	0.71	1.08	1.97	2.33	1.80	1.15	0.87	0.84
JANITIN	5.60	6.27	7.00	7.43	7.44	8.59	9.39	9.02	12.37	10.55	11.15	8.92	7.53
Std. Dev.	1.74	1.53	1.47	1.59	1.51	1.87	1.34	2.59	2.84	2.00	3.72	2.17	2.24
LYSINE	18.67	22.18	25.57	27.05	27.90	31.08	34.54	30.47	38.02	31.30	29.13	22.31	19.72
Std. Dev.	4.62	5.55	8.11	6.15	6.98	8.44	7.45	10.59	5.96	8.58	8.43	4.92	5.16
HISTIDIN	8.35	8.90	9.79	10.83	11.17	12.24	13.77	11.70	13.25	10.43	10.35	9.13	8.58
Std. Dev.	1.29	1.91	1.45	1.63	1.57	1.96	2.02	3.80	2.36	1.77	1.55	1.06	1.56
ARGININ	9.73	10.53	11.54	12.48	13.27	14.46	15.69	14.02	17.37	14.50	13.38	9.83	8.78
Std. Dev.	1.67	1.63	2.42	1.84	3.03	3.47	2.57	4.87	4.20	5.43	4.99	2.04	2.01

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS TAURINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
SMITH, N	6.62	5.87	5.29	4.98	4.26	9.00	6.44	8.55	7.27	5.23	6.11	5.81
MUELLER, G	4.08	4.91	5.01	5.11	5.76	5.30	5.53	5.16	4.20	4.62	5.20	4.09
MUESSIG, J	4.66	4.71	5.66	6.47	7.14	8.32	9.62	6.77	7.86	4.92	4.66	4.02
HUMMEL, L	4.19	5.04	4.73	6.71	6.68	6.89	6.75	6.16	6.16	6.24	4.89	4.83
MERNYMAN, J	4.49	5.14	5.55	6.34	6.55	7.62	6.76	5.24	4.39	4.81	4.47	4.73
HAWLEY, J	4.04	5.07	5.41	5.36	5.43	9.42	7.92	6.80	5.56	5.70	5.70	5.01
MEAN	5.01	5.13	5.41	5.83	6.27	7.76	7.17	6.45	5.91	5.25	5.17	4.75
STD. DEV	1.11	0.40	0.59	0.76	0.61	1.51	1.42	1.25	1.49	0.61	0.63	0.66
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

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MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS ASPART

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
HAILEY,	0.28	0.04	0.06	0.06	0.02	0.09	0.19	1.07	2.31	1.18	0.81	0.52	0.000000
MERRYNAN	0.30	0.36	0.51	0.75	0.68	0.75	1.40	1.22	1.06	0.75	0.54	0.52	0.39
MUMMEL,	0.28	0.36	0.36	0.28	0.37	0.69	0.85	0.64	0.93	0.38	0.92	0.36	0.27
MUESSIG,	0.43	0.70	0.83	0.86	0.90	1.08	1.07	1.50	1.32	1.13	0.56	0.52	0.42
SMITH, K	2.19	0.16	0.19	0.15	0.27	0.42	0.59	0.56	1.02	0.94	0.74	0.24	0.18
MUELLER,	0.10	0.14	0.12	0.17	0.16	0.21	0.21	0.18	0.18	0.17	0.11	0.09	0.06
MEAN	0.26	0.29	0.34	0.38	0.40	0.54	0.72	0.86	1.14	0.84	0.61	0.37	0.26
STD. DEV	0.11	0.24	0.29	0.34	0.33	0.37	0.48	0.49	0.69	0.37	0.29	0.18	0.15
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	5.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS THREON

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER,	14.36	17.61	16.23	20.24	20.65	25.30	23.58	26.30	25.81	26.12	27.96	21.88	19.03
MERRYNAN	13.68	16.10	16.72	18.00	16.14	15.81	19.06	18.26	7.06	15.62	15.40	13.54	14.58
MUESSIG,	14.87	16.11	20.45	20.80	22.75	21.50	21.46	24.78	22.80	19.70	16.98	15.89	14.45
SMITH, K	14.38	14.82	16.39	18.38	18.36	20.48	19.36	17.79	24.32	25.19	26.69	19.86	14.10
MAYLEY,	6.61	9.95	11.21	11.39	10.14	11.56	13.74	18.14	21.80	16.85	15.64	14.73	10.34
MUMMEL,	15.42	14.61	18.31	16.78	18.54	22.03	19.61	19.42	18.63	18.11	19.58	13.71	12.36
MEAN	13.22	14.53	16.55	17.60	17.76	19.45	19.46	20.78	20.07	20.26	20.37	16.40	14.14
STD. DEV	3.29	2.58	3.07	3.38	4.36	4.93	3.28	3.76	6.82	4.69	5.60	3.47	2.89
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS SERINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MA'LEV, M	9.69	13.22	14.60	18.43	13.52	15.54	16.99	22.59	23.68	18.68	17.95	17.65	13.73
MU'ELLER, M	14.35	13.87	16.68	18.89	16.34	18.61	16.27	16.77	15.35	18.68	15.39	12.64	11.79
SMITH, K	14.83	15.02	16.68	18.89	19.41	20.68	19.77	17.23	22.31	21.47	21.14	15.18	14.70
MU'ESSIG, M	13.22	15.08	14.57	13.25	14.26	13.38	13.10	14.97	13.38	12.69	10.22	10.18	9.30
MERRYNAN, M	9.18	9.92	11.86	12.71	10.95	10.30	12.85	11.77	10.63	9.36	9.34	9.31	9.69
MU'ELLER, M	10.60	11.70	12.40	14.60	16.88	19.90	18.16	18.78	18.41	18.12	15.82	15.92	12.81
MEAN	11.48	13.12	14.02	15.58	15.23	16.40	16.19	17.02	17.29	16.06	14.98	13.48	12.00
STD. DEV	2.46	2.01	1.94	2.93	2.95	4.06	2.76	3.63	5.11	4.91	4.52	3.32	2.17
N	6.	6.	5.	5.	6.	6.	6.	6.	6.	5.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS ASPARAGINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MU'ELLER, M	4.06	5.14	3.56	3.00	3.76	8.02	9.09	9.03	8.00	7.20	2.17	3.50	2.94
MERRYNAN, M	3.69	5.79	7.91	8.77	7.28	6.96	8.91	7.58	7.96	4.17	5.77	4.98	4.60
SMITH, K	8.37	8.10	9.69	10.39	9.86	9.64	9.57	7.14	8.67	11.39	6.30	5.58	5.13
MA'LEV, M	2.98	4.22	5.43	4.26	4.08	6.01	7.55	3.97	4.61	3.22	3.15	2.65	2.54
MU'ELLER, M	3.79	4.62	7.09	6.40	6.61	6.46	5.79	7.00	5.85	5.85	6.33	2.64	3.81
MU'ESSIG, M	1.30	3.59	5.24	4.99	7.48	7.57	7.47	8.32	7.56	6.84	6.62	5.71	6.26
MEAN	4.03	5.24	6.49	6.30	6.51	7.45	8.06	7.17	7.11	6.44	5.39	4.21	4.55
STD. DEV	2.35	1.59	2.19	2.81	2.29	1.31	1.40	1.74	1.55	2.87	2.30	1.38	1.71
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

MEAL STUDIES
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS GLUTAMIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MERRYMAN	66.01	56.14	56.43	57.58	51.31	48.76	53.69	52.71	47.01	47.14	48.64	47.16	56.32
SMITH, K	55.18	51.70	54.40	59.80	57.19	62.41	57.08	48.40	56.23	49.26	53.74	47.99	50.10
MUJESSIG	56.49	52.62	59.04	56.71	61.72	60.18	64.31	70.31	69.37	55.68	59.19	58.30	59.27
MUMMEL	55.32	49.57	65.35	59.45	56.15	59.64	58.63	63.11	63.08	64.27	64.51	55.60	49.30
MAYLEY	27.34	36.76	39.79	41.04	38.29	37.27	41.45	41.18	42.54	36.43	35.77	32.09	25.86
MUELLER	65.42	67.37	69.43	79.32	75.39	72.45	60.78	62.17	61.66	63.71	65.73	67.85	62.09
MEAN	53.96	52.03	57.41	58.65	56.67	56.78	55.99	56.31	56.65	52.71	54.60	51.50	50.16
STD. DEV	13.79	9.79	10.30	12.30	12.19	12.18	7.96	10.78	10.20	10.68	11.26	12.15	12.91
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS GLUTAMAT

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER	5.68	7.56	6.69	10.35	7.85	10.63	10.12	9.13	9.20	8.72	7.57	4.78	4.60
MANLEY	1.74	1.56	2.25	2.61	2.21	5.41	7.33	7.50	11.61	7.51	7.37	6.90	4.78
SMITH, K	2.56	2.38	3.12	3.13	4.97	6.06	7.25	6.04	8.87	6.80	5.96	3.12	2.98
MUMMEL	9.87	11.11	14.11	9.40	9.14	16.59	16.43	11.90	16.68	15.42	17.60	12.01	10.48
MUJESSIG	3.31	7.20	9.78	9.03	9.91	8.75	10.04	12.27	10.13	11.29	6.51	5.86	2.05
MERRYMAN	5.07	5.06	7.76	9.75	7.96	7.47	12.38	11.06	9.96	8.19	6.76	6.94	4.65
MEAN	4.70	5.81	7.28	7.38	7.01	8.82	10.59	9.45	11.07	9.45	8.43	6.40	4.92
STD. DEV	2.94	3.56	4.38	3.52	2.89	3.40	3.44	2.52	2.91	3.22	4.43	3.01	2.94
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

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MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS PROLINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUMMEL	19.34	21.62	25.36	23.63	25.30	27.88	26.39	27.34	26.63	21.17	24.20	18.34	16.23
MUESSIG	23.75	25.57	29.89	28.42	30.88	29.78	30.04	34.89	32.96	21.92	23.56	24.00	21.32
SMITH, R	19.01	19.00	21.57	25.84	26.87	31.30	29.06	25.00	28.00	26.91	26.81	20.43	18.90
MERYMAN	16.46	18.54	22.07	23.97	21.56	21.02	25.83	23.13	20.98	18.63	18.09	15.98	17.08
MALFY	9.56	13.83	12.06	16.59	16.30	20.17	23.55	22.43	24.81	19.37	17.16	16.00	13.67
MUELLER	21.16	26.67	23.96	29.32	28.24	35.34	32.99	34.43	33.96	32.62	29.04	29.23	26.45
MEAN	18.35	20.87	22.48	24.63	24.86	27.58	27.98	27.87	27.89	23.44	23.14	20.64	18.92
STD. DEV	6.92	4.79	5.92	4.56	5.22	5.95	3.38	5.53	4.93	5.36	4.71	5.17	4.45
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS CITRULLIN

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER	2.20	2.31	1.56	1.75	0.57	2.27	2.66	3.63	3.51	3.85	3.10	2.75	2.30
MAYLEY	2.72	3.29	2.99	2.41	1.83	1.56	2.32	4.40	4.01	5.87	5.03	5.88	4.70
MERYMAN	2.56	2.19	2.12	1.76	0.83	1.36	1.79	1.99	2.24	2.51	2.25	2.01	1.97
MUESSIG	3.55	3.58	3.28	2.92	2.65	2.32	2.80	3.63	4.01	3.25	3.29	3.10	1.95
SMITH, R	4.08	3.84	3.38	3.20	2.74	2.79	2.68	2.93	3.90	4.74	5.47	4.02	3.40
MUMMEL	1.48	1.38	1.64	1.57	1.15	1.02	1.10	1.50	1.36	1.72	1.95	1.77	1.42
MEAN	2.76	2.76	2.49	2.27	1.63	1.89	2.22	3.01	3.50	3.66	3.51	3.25	2.42
STD. DEV	0.93	0.95	0.82	0.68	0.93	0.68	0.66	1.10	1.61	1.51	1.44	1.52	1.21
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS GLYCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
SMITH, R	33.10	34.75	35.94	38.84	36.46	39.22	36.86	31.85	37.19	34.20	31.93	26.58	24.70
MUMFEL	23.12	20.69	26.83	24.55	25.80	28.01	24.14	25.32	22.47	20.62	21.92	17.72	16.78
MUESSEG	23.62	22.58	27.13	27.38	29.16	25.99	25.29	27.66	24.13	19.66	18.74	18.95	17.39
MERRYMAN	24.31	21.66	24.00	25.57	22.46	21.40	24.55	21.78	18.37	16.31	16.50	15.83	17.15
MANLEY, R	13.88	17.66	18.03	17.76	16.38	18.02	20.62	23.84	23.41	17.48	19.49	20.11	16.41
MULLER, R	22.41	27.17	25.02	30.67	30.79	36.45	31.81	31.00	30.57	29.62	26.19	26.65	23.83
MEAN	22.91	24.08	26.16	27.46	26.84	28.18	27.22	26.91	26.02	22.99	22.46	20.97	19.38
STD. DEV	5.22	6.07	5.82	7.01	6.97	8.30	5.95	4.00	6.74	7.23	5.69	4.59	3.81
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS ALANINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MULLER, R	22.63	27.63	26.10	33.42	36.18	42.90	34.35	33.71	33.12	31.23	26.36	27.29	22.27
MANLEY, R	17.25	25.83	28.83	30.95	30.38	33.07	35.37	35.35	34.29	27.22	28.03	27.19	24.69
MERRYMAN	33.47	34.93	40.53	44.23	37.28	34.03	36.23	29.91	26.80	24.91	23.98	20.08	23.65
MUESSEG	29.86	31.33	40.18	41.42	45.75	43.17	40.93	48.00	43.96	25.25	29.62	29.27	29.56
SMITH, R	31.97	34.20	39.32	46.72	50.48	57.94	52.43	43.20	42.39	39.53	37.08	29.07	25.80
MUMFEL, R	36.39	37.52	54.89	52.31	52.26	51.69	43.33	49.77	43.76	42.74	39.44	29.23	24.77
MEAN	28.59	31.91	38.31	41.51	42.05	43.80	40.45	39.99	37.39	31.81	30.75	27.02	25.12
STD. DEV	7.24	4.50	10.23	8.10	8.75	9.74	6.85	8.16	7.05	7.53	6.15	3.53	2.48
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS A_AMINO

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUMMEL	4.02	3.65	3.70	3.87	3.74	4.10	4.38	4.83	5.24	5.41	5.69	5.10	4.66
SMITH, K	0.88	0.81	0.87	0.93	0.90	1.04	0.98	0.88	1.10	1.16	1.30	1.22	1.21
MUESSIG	1.72	2.03	2.33	2.34	2.42	2.31	2.41	3.12	3.23	3.33	3.37	3.30	3.10
MAYLE V.	1.93	3.31	3.44	3.12	2.88	2.87	2.49	3.26	3.86	3.94	4.73	4.64	3.58
MCNRYMAN	1.53	1.49	1.48	1.63	1.36	1.43	1.82	1.83	1.85	2.17	2.45	2.53	2.89
MULLER	1.88	2.49	2.32	2.27	2.59	2.85	2.93	3.48	3.14	4.06	3.96	4.07	3.47
MEAN	1.99	2.30	2.36	2.36	2.31	2.43	2.50	2.90	3.07	3.34	3.58	3.48	3.15
STD. DEV	1.06	1.08	1.09	1.04	1.03	1.11	1.14	1.38	1.47	1.53	1.58	1.44	1.13
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS VALINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUELLER	16.69	20.46	18.95	23.87	24.16	29.73	29.32	35.86	35.20	38.68	34.57	32.06	28.68
PERRYMAN	22.17	23.47	27.83	29.86	27.15	34.53	36.53	36.18	36.63	35.18	34.73	31.35	32.33
MAYLE V.	17.06	23.21	26.24	25.42	23.67	26.21	31.53	37.86	49.02	45.90	43.22	39.12	31.39
SMITH, K	11.06	11.32	12.71	13.50	13.66	16.18	15.16	14.82	24.30	30.05	33.29	22.03	18.60
MUMMEL	35.98	34.31	42.82	37.65	36.29	42.07	43.99	43.63	47.64	51.08	54.58	43.44	38.58
MUESSIG	20.43	22.26	27.72	25.83	29.48	28.58	30.18	38.70	39.53	39.14	33.89	30.84	26.16
MEAN	20.56	22.50	26.04	26.02	25.73	28.28	30.78	34.51	38.72	40.00	39.05	33.14	29.23
STD. DEV	8.46	7.35	10.15	7.90	7.48	8.31	9.33	10.04	9.07	7.51	8.45	7.42	6.70
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

PEAR STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS CYSTINE

SUBJECT / TIME	5 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESIG.	10.49	12.02	13.27	12.17	12.93	11.17	11.11	11.84	10.86	7.06	10.06	9.95	9.21
MERRYMAN	7.35	6.65	7.51	7.00	6.96	6.41	7.22	6.57	5.93	6.13	6.25	6.36	7.21
PUMMEL.	8.58	8.85	10.16	9.51	8.24	8.25	7.93	7.58	8.33	7.79	7.36	7.27	6.30
SMITH, R	9.69	9.99	9.97	10.63	10.35	10.81	10.14	8.86	10.25	10.30	10.96	8.86	8.74
MUELLER.	8.43	9.52	8.24	9.32	9.04	10.83	9.30	9.97	9.70	9.40	8.81	8.93	8.45
MANLEY.	7.54	10.04	10.62	9.74	8.85	9.15	10.53	12.97	13.57	11.92	12.05	12.17	11.95
MEAN	8.68	9.51	9.96	9.86	9.40	9.44	9.37	9.63	9.77	8.80	9.25	8.92	8.65
STD. DEV	1.22	1.76	2.02	1.46	2.05	1.87	1.53	2.46	2.56	2.18	2.20	2.04	1.94
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS METHION

SUBJECT / TIME	5 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MANLEY.	2.21	3.22	3.49	3.81	3.81	4.51	5.67	7.03	6.00	6.58	4.55	3.45	2.91
MUELLER.	3.04	3.15	3.33	4.00	4.15	5.81	6.11	6.99	7.12	5.45	5.40	4.11	3.20
SMITH, R	3.50	3.91	3.27	4.42	4.62	4.69	5.26	5.84	6.70	7.81	6.81	5.10	3.95
PUMMEL.	3.19	3.51	4.70	5.36	5.43	5.72	6.12	6.50	6.58	7.03	5.65	3.50	3.25
MUESIG.	2.92	3.60	4.99	4.56	4.92	5.50	5.63	3.39	3.36	4.45	3.54	3.10	2.97
MERRYMAN	2.38	2.78	3.85	4.50	4.15	4.55	5.70	5.39	5.40	4.88	3.62	2.58	2.51
MEAN	2.87	3.36	3.94	4.44	4.51	5.13	5.75	5.92	5.86	6.03	4.93	3.64	3.13
STD. DEV	0.49	0.40	0.74	0.54	0.60	0.61	0.33	1.42	1.36	1.31	1.27	0.87	0.48
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

MEAL STUDIES
- INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS ISOLEUCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MERTYMAN	5.77	8.34	10.70	9.94	10.84	10.80	14.32	15.53	16.61	14.31	13.50	11.53	11.08
MUESSEIG	6.58	7.39	10.25	10.16	11.15	11.49	12.48	16.92	17.38	15.66	12.41	11.30	9.14
SMITH, K	3.69	5.61	4.67	6.47	6.84	8.05	7.72	7.32	13.56	17.33	17.83	7.70	7.71
MULLER, K	5.36	6.87	4.86	8.56	8.12	9.46	11.84	12.94	26.08	22.34	17.07	13.19	9.61
MULLER, K	7.13	8.99	8.44	10.76	11.12	14.07	14.28	17.50	17.35	18.93	16.10	13.81	11.77
MUMMEL	10.12	10.59	14.45	12.61	12.62	15.52	16.53	16.53	19.08	20.32	21.93	15.35	13.08
MEAN	6.44	7.96	8.89	9.75	10.11	11.54	12.86	14.46	18.34	18.14	16.51	12.15	10.40
STD. DEV	2.15	1.74	3.75	2.08	2.17	2.80	3.01	3.85	4.20	2.98	3.39	2.65	1.95
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS LEUCINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MULLER, K	11.73	15.00	14.05	18.15	18.39	23.11	23.29	28.15	27.90	29.91	25.19	21.62	10.42
MUMMEL	20.55	21.06	28.39	24.33	25.04	30.12	31.23	30.16	34.34	36.21	37.41	25.94	18.45
MULLER, K	9.47	13.16	13.68	15.52	14.54	16.35	20.37	31.98	44.49	37.06	28.52	23.50	17.53
MUESSEIG	12.65	14.50	20.09	19.05	20.91	20.79	22.51	30.25	20.79	27.39	21.56	14.54	16.20
SMITH, K	8.25	10.07	10.02	11.65	11.83	13.32	12.22	11.62	21.11	26.60	27.32	13.33	12.10
MERTYMAN	12.26	15.36	19.44	19.81	19.06	18.94	25.22	26.53	27.86	23.92	22.19	19.27	18.94
MEAN	12.48	14.86	17.61	18.08	18.29	20.44	22.47	26.45	29.45	30.16	27.03	20.53	17.63
STD. DEV	4.31	3.60	4.50	4.26	4.67	5.84	6.24	7.50	8.91	5.36	5.78	4.39	3.44
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

March 7, 1977

MEAL STUDIES - INDIVIDUAL DATA
PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS TYROSINE

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MEHMAN	6.23	7.06	8.79	9.78	8.89	8.77	11.37	10.95	10.36	9.25	8.86	7.61	7.58
SMITH, R	4.55	5.10	5.83	6.50	6.71	7.62	7.65	6.92	9.63	10.28	10.67	7.32	6.80
MUESSIG	6.13	7.82	9.91	9.22	10.25	9.84	10.14	12.62	12.47	10.14	8.40	7.22	6.41
MAYLEY	3.72	5.00	6.08	6.35	6.23	7.25	8.95	12.56	15.71	13.46	10.44	8.87	7.08
MJELLER	6.44	5.93	5.56	7.25	7.39	9.39	9.39	10.54	10.45	10.14	8.45	7.73	6.13
MUMMEL	6.48	7.39	10.23	8.93	9.24	10.82	10.64	10.32	10.15	9.83	9.91	6.56	5.43
MEAN	5.26	6.38	7.73	7.99	8.12	8.95	9.69	10.65	11.46	10.52	9.45	7.55	6.57
STD. DEV	1.16	1.21	2.15	1.49	1.58	1.35	1.32	2.08	2.30	1.49	1.01	0.76	0.76
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS PHENYLAL

SUBJECT / TIME	3 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUESSIG	4.90	7.68	8.90	7.84	8.51	7.88	8.05	10.34	9.85	6.14	6.33	5.92	5.40
MAYLEY	3.76	9.58	9.66	9.21	8.61	9.45	10.03	12.28	13.79	11.20	8.70	7.60	6.68
MULLER	5.43	7.24	6.61	8.16	7.86	9.33	8.27	8.10	7.99	7.49	5.96	5.69	4.60
SMITH, R	4.32	6.13	6.78	7.53	7.77	8.46	8.26	7.16	8.12	8.54	8.59	5.55	5.18
MEHMAN	5.27	7.65	9.18	9.67	8.49	7.84	10.27	8.83	8.27	7.05	6.91	6.07	6.26
MUMMEL	5.37	6.61	8.83	7.45	7.54	8.15	7.77	7.38	7.41	6.93	7.05	5.05	4.71
MEAN	4.84	7.48	8.33	8.31	8.13	8.52	8.77	9.01	9.34	7.89	7.26	5.98	5.47
STD. DEV	0.67	1.19	1.30	0.92	0.46	0.71	1.08	1.97	2.33	1.80	1.15	0.87	0.84
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS ORNITHINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
PUELLER	0.74	9.18	8.43	10.17	10.21	11.64	11.79	13.08	13.10	13.32	11.69	11.96	10.4
MURMEL	5.82	5.87	8.52	7.36	7.76	9.48	9.73	9.57	9.97	10.76	15.94	10.45	9.5
SMITH, K	5.83	6.59	7.04	7.90	7.62	9.08	9.49	9.03	11.54	12.39	15.22	9.63	7.8
MANLEY	4.04	4.80	4.62	5.40	5.82	6.94	8.40	8.36	15.34	8.99	7.77	6.18	4.3
MUSSIIG	5.17	5.61	7.23	7.14	7.92	7.73	7.96	4.99	15.62	9.65	8.31	8.23	6.2
MURRYMAN	4.00	5.63	6.17	6.64	6.49	6.68	9.00	9.11	8.65	8.18	8.00	7.05	6.7
MEAN	5.60	6.27	7.00	7.43	7.64	8.59	9.39	9.02	12.37	10.55	11.15	11.92	7.
STD. DEV	1.74	1.53	1.47	1.59	1.51	1.87	1.34	2.59	2.84	2.03	3.72	2.17	2.
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

PLASMA AMINO ACIDS

MEAL APM MSG. DOSE = 34 MG/KG

VARIABLE IS LYSINE

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
MUSSIIG	21.25	24.13	33.12	32.29	35.91	34.50	35.31	15.36	47.22	22.23	25.36	24.27	22.8
MURRYMAN	21.38	30.74	31.56	31.19	30.39	31.50	42.50	39.16	36.58	30.14	27.48	23.00	24.1
MANLEY	11.93	16.21	17.00	19.85	20.64	23.78	28.80	25.11	30.14	19.94	15.83	13.46	10.6
SMITH, K	13.62	15.87	16.24	18.57	17.99	18.42	22.67	23.72	34.00	38.14	38.46	20.60	16.5
MUSSIIG	21.44	23.09	22.02	29.45	31.40	38.76	38.65	42.09	41.54	38.38	29.94	27.68	22.0
MURMEL	22.40	23.02	33.49	30.95	31.09	39.54	39.34	37.39	38.65	38.96	37.70	24.87	21.0
MEAN	18.67	22.18	25.57	27.05	27.90	31.08	34.54	30.47	38.02	31.30	29.13	22.31	19.
STD. DEV	4.62	5.55	8.11	6.15	6.98	8.44	7.45	10.59	5.96	8.58	8.43	4.92	5.
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

TABLE 5: Plasma amino acid levels (umoles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

MEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS MISTIDIN

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
HUMMEL, J.	6.90	6.25	9.79	9.09	10.08	11.83	11.32	10.59	10.49	11.02	12.27	8.66	7.55
MUELLER, R.	9.26	9.82	9.87	12.61	13.18	15.98	15.36	15.33	15.08	13.25	10.34	10.41	9.09
SMITH, K.	7.94	8.67	8.90	10.59	9.80	10.59	12.72	13.18	12.46	10.46	11.41	6.48	8.40
HANLEY, V.	6.93	7.82	7.67	9.07	9.49	11.01	14.16	11.63	12.21	8.83	6.10	7.72	6.66
MERRYMAN	10.12	11.92	11.90	12.63	12.41	12.63	16.70	14.48	12.23	10.78	10.95	10.27	11.21
MUESSIG, J.	8.88	8.90	10.64	10.82	12.06	11.42	12.34	4.79	17.02	8.25	9.03	9.27	8.66
MEAN	8.35	8.90	9.79	10.83	11.17	12.24	13.77	11.70	13.25	10.43	10.35	9.13	8.58
STD. DEV	1.29	1.91	1.45	1.63	1.57	1.96	2.02	3.80	2.36	1.77	1.55	1.06	1.56
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

APM-MSG MEAL STUDY

PLASMA AMINO ACIDS

MEAL APM MSG, DOSE = 34 MG/KG

VARIABLE IS ARGININ

SUBJECT / TIME	0 MIN	15 MIN	30 MIN	45 MIN	1 HR	90 MIN	2 HR	3 HR	4 HR	5 HR	6 HR	7 HR	8 HR
HUMMEL, J.	10.44	11.57	15.80	14.61	15.83	14.94	15.60	6.99	19.55	10.36	10.21	9.33	8.85
MUESSIG, J.	8.92	11.74	11.73	12.15	11.59	11.08	15.26	14.98	13.42	10.87	9.81	8.27	8.85
MERRYMAN	8.01	9.44	9.60	10.76	11.12	12.71	15.64	13.76	16.24	11.59	9.59	8.41	6.81
SMITH, K.	11.33	11.65	12.09	13.94	13.40	14.32	15.54	14.73	20.67	22.24	22.22	12.03	10.10
MUELLER, R.	11.75	11.07	8.94	13.43	17.80	20.97	20.10	21.92	22.45	23.69	16.17	12.75	11.93
HUMMEL, J.	7.94	7.71	11.10	9.98	9.89	12.74	12.03	11.75	11.92	11.27	12.27	8.17	6.66
MEAN	9.73	10.53	11.54	12.48	13.27	14.46	15.69	14.02	17.37	14.53	13.38	9.83	8.78
STD. DEV	1.67	1.63	2.42	1.84	3.03	3.47	2.57	4.87	4.20	3.43	4.99	2.04	2.01
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.

March 7, 1977

TABLE 5: Plasma amino acid levels (μ moles/dl) in normal adults fed a high protein meal (1 gm/kg) containing added MSG (34 mg/kg) and added ASPARTAME (34 mg/kg).

Table 6
EXPECTED DAILY INTAKE OF MONOSODIUM GLUTAMATE
BASED ON PERSON-DAYS
(Means and Percentiles by Age)†

Total Sample				
Intakes, mg/kg/day				
Age	Mean	90th PCTL	99th PCTL	99.9th PCTL
0-5 months	0.3	0	11	25
6-11 months	1.9	1.9	36	46
12-23 months	6.8	30	43	61
2-5 years	5.5	23	37	56
5-17 years	2.7	10	25	40
18+ years	1.5	7	12	19

† Reference 24

March 7, 1977

Table 7

ESTIMATE OF ASPARTAME INTAKE IN A 70 KG MAN
WITH AN ENERGY REQUIREMENT OF 2500 KCAL PER DAY

A. Sucrose Intake as 17% of Energy

<u>Kcalories</u>	<u>Sucrose</u>	<u>Sucrose Intake</u>	<u>ASPARTAME Equivalent</u>
425	104 g	1500 mg/kg	7.5-8.3 mg/kg

B. Total Carbohydrate Intake as 50% of Energy

<u>Kcalories</u>	<u>Carbohydrate</u>	<u>Sucrose Equivalent</u>	<u>ASPARTAME Equivalent</u>
1250	313 g	4470 mg/kg	22-25 mg/kg

FINAL REPORT

Plasma Aminograms of Infants & Adults
Fed An Identical High Protein Meal


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PLASMA AMINOGRAMS OF INFANTS & ADULTS
FED AN IDENTICAL HIGH PROTEIN MEAL

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Adibi and Mercer have shown that exogenous protein is the principal source of increased free amino acids in plasma (1). These investigators reported increases in plasma concentrations of lysine, alanine, leucine and valine whenever fasted healthy young adult males were fed 50 grams of purified bovine serum albumin. In addition they observed that the digestion of protein ingested as a meal component extends over a time period in excess of 4 hours.

The movement of amino acids from the gut into the peripheral circulation is complex, being dependent upon a number of transport and metabolic processes. What effect if any age plays in these homeostatic processes has not been determined.

We have investigated the ability of the infant to metabolize amino acids relative to that of the adult by feeding an identical high protein meal to fasted subjects, measuring changes in plasma free amino acid concentrations with time. We were particularly interested in the capacity of the infant to regulate metabolism of the dicarboxylic acids, glutamic and aspartic acids and phenylalanine.

METHODS

Sixteen healthy one-year-old and 8 healthy two-year-old infants and

6 healthy young adults (3 male and 3 female) were given a chocolate-flavored custard following an overnight fast. The custard, whose composition is shown in Table I, contained 14 percent by weight protein. Each subject was fed an amount of custard to provide protein at one gram per kilogram body weight. A typical one-year-old infant was fed approximately 70 grams of custard and a typical 70 kilogram male ingested 500 grams.

The amino acid composition of the custard was calculated from the amino acid composition of milk and egg as published by Orr and Watt (2). Calculated intake of amino acids for each subject is given in Tables IIA and IIB.

Heparinized blood samples for amino acid analysis were collected serially on both infants and adults. Each adult was studied over a period of 6 hours with blood samples (7 ml) collected via an indwelling 20 gauge needle at intervals of 0, 30, 60, 90, 120, 150, 180, 240, 300 and 360 minutes following feeding. A dilute heparin solution was instilled into the needle to maintain patency between bleedings. Two venous blood samples (3 ml) were collected from each infant. All infants provided a fasting specimen. Blood samples were obtained on four one-year-old infants and four two-year-old children one hour after feeding and on four one-year-old infants and four two-year-old children two hours after feeding. Blood samples were obtained on four one-year-old infants three hours after feeding and on four one-year-old infants four hours after feeding.

The proposed study was explained to each subject or their parents in the case of the infants and children and informed written consent was obtained. The project was reviewed and approved by the Human Subjects Committee of

the University of Iowa prior to its initiation.

Blood samples for amino acid analyses were centrifuged immediately to separate plasma and erythrocytes. The plasma was deproteinized with sulfo-salicylic acid according to the method of Efron (3) and analyzed immediately or stored at -70°C to prevent loss of glutamine and cystine (4,5). Amino acid analyses were carried out on a Beckman 121M analyzer.

Response to the protein load was determined by plotting the change in plasma concentration of each amino acid as a function of time. Such plots enable one to determine peak response and area under the curve as well as provide a means for comparison of infant to adult response.

RESULTS

Plasma free amino acid concentrations following ingestion of a protein load of one gram per kilogram body weight are given in Table III for adults and in Table IV for infants. The response of infants and adults to an identical protein load at one gram per kilogram body weight is shown in Figure 1 for aspartic acid, glutamic acid, tyrosine and phenylalanine. It is evident that infants have a slightly higher fasting plasma concentration of free aspartic and glutamic acids than adults, while fasting plasma concentrations of free tyrosine and phenylalanine do not differ with age. The milk-egg protein load of one gram per kilogram body weight produced a similar rise in plasma concentration of aspartic acid, glutamic acid, phenylalanine and tyrosine in both infants and adults.

Fasting and postprandial plasma concentrations for 10 indispensable amino acids in infants and these same amino acids in adults are compared in Table V. Concentrations of free amino acids in fasting and postprandial blood samples representing peak response to the feeding of custard are comparable for both infants and adults. Changes in concentration of plasma free amino acids in adult subjects given the egg-milk protein mixture are comparable to those reported by Adibi and Mercer for adults fed bovine serum albumin.

Using the method described by Swendseld and co-workers (6), the ratio of essential to nonessential amino acids was calculated. In the fasting state these ratios were 0.48 and 0.56 for infants and adults respectively. In the postprandial state these ratios were 0.61 for infants and 0.69 for adults. Swendseld and co-workers reported ratios of essential to nonessential amino acids of 0.5 for fasting young adults after 7 days on diets providing approximately 90 grams of protein per day.

The change in plasma concentration of free glutamic and aspartic acids, phenylalanine and tyrosine following the feeding of one gram per kilogram body weight of protein is comparable in infant and adult (Table VI). Postprandial concentrations of glutamic and aspartic acids, phenylalanine and tyrosine of 9, 1, 9 and 11 uMoles/dl, respectively, observed in these infants are comparable to postprandial concentrations of these amino acids found in infants fed either human milk (7) or various commercial infant formula products (8) (Table VII). With the latter feedings, the load of glutamic acid is 25 to 40 percent of that supplied by the custard. The loads of aspartic acid, phenylalanine and tyrosine are 20 to 70 percent of that supplied by the custard.

Marrs and co-workers have suggested a means for determining whether there is any relationship between the amino acid composition of a meal and increments of plasma concentrations of individual amino acids (9). On the basis of plasma aminograms obtained on blood samples collected serially following a test meal an absorption curve is plotted for each amino acid. The area under the curve for each amino acid is determined and this value is plotted as a function of the molar ratio of each amino acid in the test mixture relative to histidine. When Marrs and co-workers studied a casein hydrolysate and an amino acid mixture resembling casein according to this procedure, they established that amino acids from these mixtures were absorbed in a comparable manner, i.e. a plot of area versus relative composition was found to fit a common regression line.

This method of analysis has been applied to the aminogram data obtained on the infant and adult subjects fed custard. The molar ratio for 15 amino acids relative to histidine (indexed at one) was calculated from the amino acid composition of the custard. Area under the curve in arbitrary units was calculated for these amino acids (Table VIII) and plotted as a function of relative molar ratio (Figure 2). Individual amino acids in this figure are identified according to the one-letter notation employed in the Atlas of Protein Sequence and Structure (10). If the infant and adult transport and metabolize the egg-milk load in a similar manner, the data should fit a common regression line. As shown in Figure 2, adults and infants have a similar regression line. Calculated

coefficients of correlation are: adults $r = 0.73$; infants $r = 0.81$.

SUMMARY

Plasma aminograms of normal healthy infants fed a milk-egg custard meal providing a protein intake of one gram per kilogram body weight were comparable to plasma aminograms obtained on healthy young adults fed the same protein load.

When increments in levels of individual plasma amino acids (area under the curve) were plotted relative to the amino acid composition of the custard meal, the regression line was similar for both infants and adults.

Plasma concentrations of glutamic acid, aspartic acid, phenylalanine and tyrosine in infants fed a meal providing one gram per kilogram body weight of protein were not elevated beyond those postprandial concentrations observed in normal term breastfed infants.

These data support the conclusion that healthy one-year-old infants have the capacity to transport and metabolize aspartic acid, glutamic acid, phenylalanine and tyrosine to the same degree as normal healthy young adults.

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Table 1

COMPOSITION OF CUSTARD

COMPONENT	WEIGHT	WATER	PROTEIN	FAT	CHO
	g	g	g	g	g
Egg	150	110	20	17	1
NFDM	150	6	54	1	78
Fructose	30	0	--	--	30
Water	200	200	--	--	--
Total	530	316	74	18	109

Calculated protein content - 13.96 gm protein per 100 gm custard.

Actual protein content of each custard batch confirmed by analysis.

VAL STUDIES . . - INDIA
LASA AMINO ACIDS

SOI3Y ONI4Y V4SV7.

CUSTARD		DOSE = 0 MG/KG		VARIABLE IS ASPART									
SUBJECT / TIME		3 MIN	10 MIN	30 MIN	60 MIN	90 MIN	2 HR	2.5 HR	3 HR	4 HR	5 HR	6 HR	
WYATT, N		0.36	0.24	0.20	0.20	0.14	0.16	0.28	0.21	0.23	0.20	0.17	
FLATTEM,		0.40	0.26		0.19	0.14	0.23	0.29	0.26	0.24	0.16	0.14	
WALKER,		0.36	0.51		0.50	0.42	0.64	1.44	0.62	0.73	0.76	0.56	
WYATT, R		0.28	0.32		0.34	0.43	0.57	0.47	0.43	0.51	0.59	0.39	
ANDERSON		0.30	0.43		0.45	0.54	0.46	0.42	0.49	0.45	0.68	0.66	
MUELLER,		0.43	0.38		0.33	0.43	0.52	0.58	0.60	0.63	0.49	0.55	
MEAN		0.35	0.36	0.33		0.35	0.43	0.59	0.43	0.47	0.48	0.41	
STD. DEV		0.06	0.10	0.13		0.17	0.19	0.43	0.17	0.20	0.25	0.22	
N		6	6	6		6	6	6	6	6	6	6	

REAL STUDIES - INDIVIDUAL PLASMA AMINO ACIDS

CUSTARD • DOSE • 0 MG/KG

'TRIANGLE IS THREON'

PLASMA AMINO ACIDS

CUSTARD : DOSE : 0 MG/KG

VARIABLE IS SERINE

[illegible]

Table III: Plasma amino acids (umoles/dl) in adult subjects fed a high protein meal at 1 gm/kg body weight

CUSTARD		DOSE = 0 MG/KG											
VARIABLE IS ASPARAGIN													
SUBJECT / TIME	3 MIN	30 MIN	60 MIN	90 MIN	2 HR	2.5 HR	3 HR	4 HR	5 HR	6 HR			
FLATTICH,	6.40	11.95	10.13	11.35	10.74	11.19	11.47	9.74	9.26	7.93	0.000000	0.000000	0.000000
WYATT, R	6.48	6.12	9.24	9.39	8.73	8.38	8.07	8.27	7.73	6.88	0.000000	0.000000	0.000000
MUELLER,	10.70	12.70	12.70	13.30	10.10	13.10	16.10	16.00	14.10	12.00	0.000000	0.000000	0.000000
WYATT, N	3.75	7.56	7.72	6.79	4.49	5.66	7.17	7.66	7.61	9.17	0.000000	0.000000	0.000000
ANDERSON	3.92	5.85	6.13	5.97	6.99	6.66	5.58	5.34	5.89	6.72	0.000000	0.000000	0.000000
WALKER,	4.20	6.52	6.10	4.90	4.30	6.02	5.44	6.56	4.42	4.34	0.000000	0.000000	0.000000
MEAN	5.91	8.45	8.67	8.62	7.56	8.50	8.97	8.93	8.17	7.84	0.0	0.0	0.0
STD. DEV	2.65	3.07	2.56	3.29	2.77	3.03	4.13	3.77	3.35	2.59	0.0	0.0	0.0
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	0.	0.	0.

PLASMA AMINO ACIDS

CUSTARD DOSE = 0 MG/KG

VARIABLE IS GLUTAMINE

SUBJECT / TIME	3 MIN	30 MIN	60 MIN	90 MIN	2 HR	2.5 HR	3 HR	4 HR	5 HR	6 HR		
WALKER, R	50.40	55.00	56.30	53.50	54.30	46.50	55.00	65.10	54.70	52.90	000000	000000
ANDERSON, J	54.35	53.17	51.18	51.39	51.12	51.63	49.16	46.14	48.30	45.66	000000	000000
WYATT, N	36.47	44.68	48.51	46.18	43.46	36.20	41.23	43.20	48.05	59.77	000000	000000
MUELLER, N	43.50	43.60	49.90	47.60	42.80	47.20	47.20	48.80	48.10	44.10	000000	000000
FLATTEN, R	51.00	62.78	55.48	59.94	54.55	56.09	57.50	53.28	53.33	45.53	000000	000000
WYATT, R	54.55	55.91	62.34	54.05	52.03	51.83	49.19	50.46	48.05	43.60	000000	000000
MEAN	48.38	52.52	53.95	52.11	49.71	48.24	49.88	51.16	50.09	48.59	0.0	0.0
STD. DEV	7.08	7.27	5.14	4.96	5.27	6.86	5.78	7.66	3.07	6.43	0.0	0.0
N	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	0.	0.

Table III: Plasma amino acids (umoles/dl) in adult subjects fed a high protein CUSTARD meal at 1 gm/kg body weight

[illegible]

PLASMA AMINO ACIDS

CUSTANO , DOSE • 0 MG/KG

VARIABLE IS PROLINE-

[illegible]

INDIVIDUAL B

[illegible]

PLASMA AMINO ACIDS

CUSTARD, DOSE - 0 MG/KG

VARIABLE IS GLYCINE

[illegible]

Table VIII: Plasma amino acids (umoles/dl) in adult subjects fed a high protein CUSTARD meal at 1 gm/kg body weight

CUSTARD, DOSE - 0 MC/KG

VARIABLE IS ALANINE

[illegible]

PLASMA ONLY. SOLID

CUSTARD , DOSE • 0 MG/KG

AVAILABLE IS A-AMINO

[illegible]

REAL STUDIES - AMINO ACIDS

VARIABLE IS VALINE

[illegible]

CUSTARD , DOSE • 0 MG/KG

VARIABLE IS CYSTINE

[illegible]

Table III: Plasma amino acids (umoles/dl) in adult subjects fed a high protein CUSTARD meal at 1 gm/kg body weight

MEAL STUDIES - INDIVIDUAL PLASMA AMINO ACIDS

CUSTARD, DOSE - 0 MG/KG

VARIABLE IS 'NEYMON'

[illegible]

PLASMA AMINO ACIDS

CUSTARD , DOSE • 0 MG/KG

UNCLASSIFIED//FOR OFFICIAL USE ONLY

[illegible]

FEED STUDIES. - INDIVIDUAL PLASMA AMINO ACIDS.

[illegible]

PLASMA AMINO ACIDS

[illegible]

Table III: Plasma amino acids (umoles/dl) in adult subjects fed a high protein CUSTARD meal at 1 gm/kg body weight

[illegible]

PLASMA AMINO ACIDS

[illegible]

MEAL STUDIES, - INDIVIDUAL PLASMA AMINO ACIDS

VARIABLE IS LYSINE

[illegible]

PLASMA AMINO ACIDS

CUSTARO , DOSE - 0 MG/KG

[illegible]

Table III: Plasma amino acids (umoles/dl) in adult subjects fed CUSTARD meal at 1 gm/kg body weight

NEAL STUDIES - INDIVIDUAL DATA PLASMA AMINO ACIDS

CUSTARD, DOSE - 0 MG/KG

VARIABLE IS ARGININ

[illegible]

Table IV: Plasma amino acids (umoles/l) in the first 24 hours after birth. Data are presented as mean \pm SD. The number of infants in each group is indicated in parentheses.

PLASMA AMINO ACID LEVELS
TIME: 4 hours

VARIABLE	N	MEAN	STANDARD DEV	VARIANCE	SLM	CORRECTED SS	LCH	HIGH
ACE	4	1.000000	0.0	0.0	4.000000	0.0	1.000000	1.000000
TAURINE	4	4.972500	2.769710	7.671292	15.890000	23.013875	1.720000	0.250000
ASPARTAT	4	0.962500	0.223663	0.050025	0.850000	0.150075	0.740000	1.240000
THREONINE	4	12.952500	1.676730	2.811425	51.100000	8.434275	11.500000	14.600000
SERINE	4	14.100000	0.49667	0.202200	56.400000	0.606600	13.640000	14.570000
ASPARAGI	4	3.945000	0.932541	0.869033	15.780000	2.609000	2.900000	5.170000
GLUTAMIN	4	36.042500	11.219312	125.872958	144.170000	377.618075	21.000000	48.120000
GLUTAMAT	4	11.025000	4.145854	17.139433	44.100000	51.565300	7.030000	16.050000
PROLINE	4	33.507500	5.559359	35.513958	114.030000	106.541875	26.100000	40.510000
CITRULLI	4	2.350000	0.348234	0.121267	1.400000	0.360000	1.900000	2.700000
GLYCINE	4	16.372500	4.302491	18.511425	65.490000	55.534275	10.900000	21.400000
ALANINE	4	25.965000	9.771914	95.490300	133.260000	286.470900	12.930000	33.700000
AMINO	4	1.547500	0.734552	0.539625	6.190000	1.618075	0.640000	2.400000
VALINE	4	33.177500	13.421667	180.327092	144.710000	540.937275	20.400000	47.600000
CYSTINE	4	7.617500	0.373575	0.139558	16.470000	0.416675	7.170000	8.050000
PETHICNI	4	4.552500	1.844528	3.403750	18.210000	10.211275	1.930000	5.900000
ISOLEUCI	4	12.870000	3.367759	11.341000	31.480000	34.025400	9.820000	17.410000
LEUCINE	4	22.337500	6.148048	37.798492	15.350000	113.395475	14.070000	24.650000
TYROSINE	4	10.515000	2.637075	6.954167	42.060000	20.862500	6.870000	13.070000
PHENYLAL	4	8.000000	2.625605	6.893800	12.240000	20.681400	4.760000	10.900000
ORITHIN	4	6.837500	3.545517	12.570692	37.350000	37.712075	4.200000	11.760000
LYSINE	4	17.002500	3.557446	12.655425	48.010000	37.966275	13.350000	21.200000
PISTIDIN	4	7.032500	1.758378	3.091892	31.330000	9.275675	5.230000	8.950000
ARGININE	4	7.422500	2.900349	8.412025	17.690000	25.236075	6.200000	13.240000
PUP	4	1.152500	0.359664	0.129358	4.610000	0.388075	0.630000	1.450000

* Two two-year-old Infants refused to eat the custard after a fasting blood sample was obtained. These two Infants were averaged into the zero time values for a N = 26.

Table V

CUSTARD STUDY

PLASMA FREE AMINO ACID CONCENTRATION
FOLLOWING ONE GRAM/KBW PROTEIN

AMINO ACID UMOLS/DL	INFANT		ADULT	
	FASTING	POSTPRANDIAL	FASTING	POSTPRANDIAL
THREONINE	9.6	18.8	15.9	24.6
VALINE	20.5	41.3	23.3	43.8
1/2 CYSTINE	7.3	8.9	9.8	10.5
METHIONINE	2.0	4.8	2.9	7.1
ISOLEUCINE	6.5	13.0	7.8	13.6
LEUCINE	10.8	23.0	13.0	26.0
PHENYLALANINE	5.0	8.9	5.1	8.4
LYSINE	13.5	29.5	18.5	31.5
HISTIDINE	7.8	10.2	8.6	11.5
ARGININE	8.8	15.2	10.4	15.7

Table VI

Custard Study
Adults and One-Year-Olds

		Intake (mg/KBW)				Plasma Concentration (uMoles/dl)							
N		Glu	Asp	Phe	Tyr	Glu		Asp		Phe		Tyr	
						Fast	PP	Fast	PP	Fast	PP	Fast	PP
Adults	6	221	78	56	53	3.3	6.4	0.4	0.6	5.1	8.5	5.6	11.1
Infants	16	231	82	58	56	6.5	9.2	0.6	1.0	5.0	8.7	5.4	10.1

Glu = Glutamate
Asp = Aspartate
Phe = Phenylalanine
Tyr = Tyrosine

Table VII

Plasma Glutamate & Aspartate Concentrations
Term Infants - 2 Hours Postprandial

Feeding	N	Intake mg/KBW/Feeding			Plasma Concentration uMoles/dl			
		Glutamate	Aspartate	Phenylalanine	Tyrosine	Glutamate	Aspartate	Phenylalanine Tyrosine
Human Milk	13	64	32	14	17	12.3	0.7	4.7 8.9
Nutramigen*	8	80	28	42	17	10.1	2.1	10.7 9.5
Soy Isolate	12	95	57	23	17	13.0	0.7	5.9 7.3
Enfamil*	24	62	15	27	22	9.8	1.4	10.3 11.5

* Serum Samples

Table VIII

Area Under the Curve
Following A Custard Meal

<u>Amino Acid</u>	<u>Code Letter</u>	<u>Molar Ratio In Custard</u>	<u>Area Under Curve</u> umoles/hr/dl	
			<u>Infant</u>	<u>Adult</u>
Threonine	T	2.40	16.0	27.7
Serine	S	3.41	7.8	16.3
Proline	P	4.82	54.1	63.6
Glycine	G	1.91	-5.7	0.4
Alanine	A	3.08	37.1	69.6
Valine	V	3.62	51.2	51.5
1/2 Cystine	C	0.65	1.6	2.3
Methionine	M	1.08	7.8	12.4
Isoleucine	I	2.96	21.4	17.5
Leucine	L	4.46	36.8	39.0
Tyrosine	Y	1.65	17.8	16.8
Phenylalanine	F	1.88	10.8	7.0
Lysine	K	3.10	35.7	42.4
Histidine	H	1.00	5.4	7.7
Arginine	R	1.54	10.4	15.9
Glutamic Acid*	-	8.40	6.9	8.8
Aspartic Acid*	-	3.27	0.6	0.2

* Amino Acids not plotted in Figure 2.

PLASMA LEVELS (umoles/dl.)

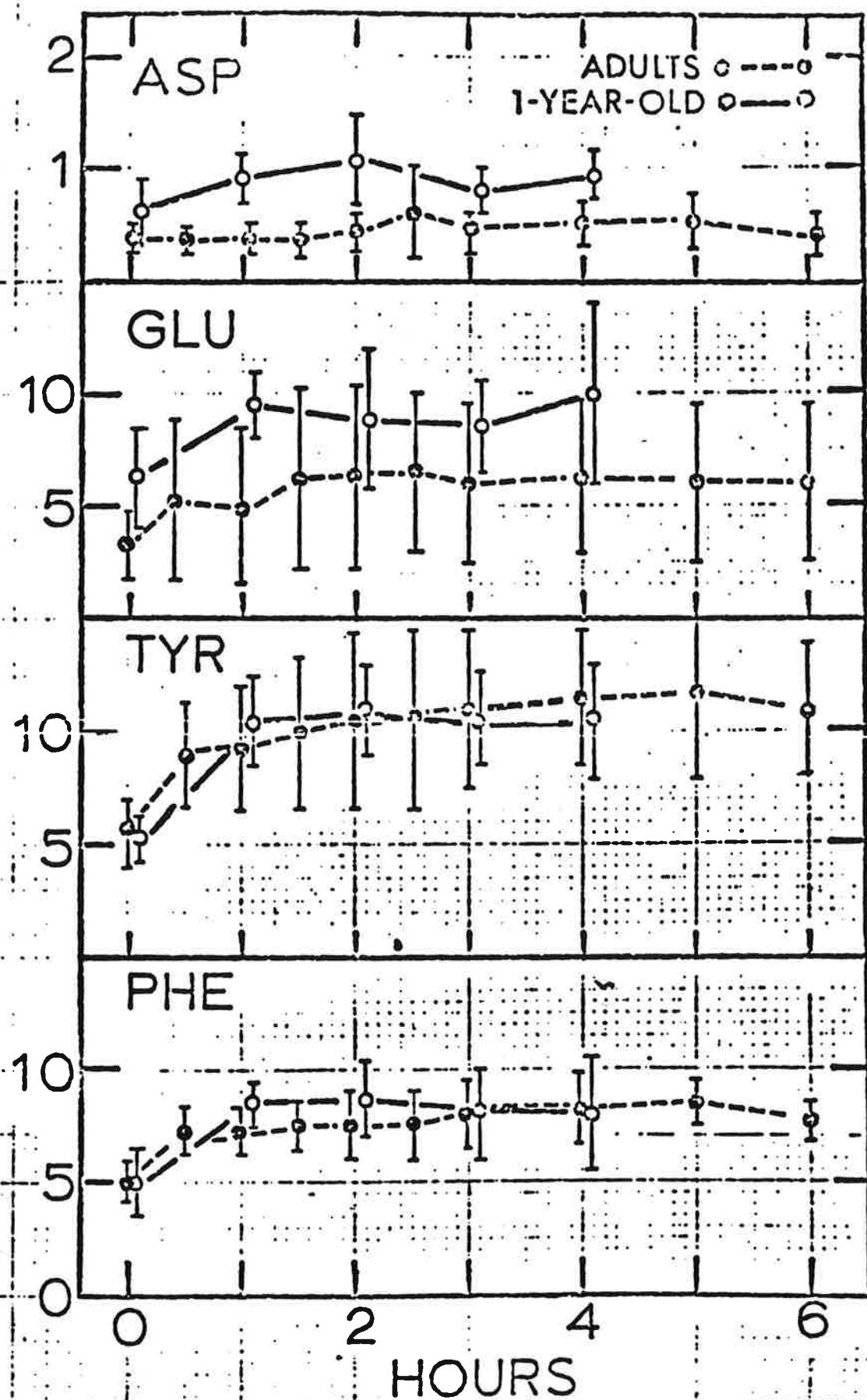


Figure 1. Plasma concentrations of aspartic acid, glutamic acid, tyrosine and phenylalanine in normal one-year-old infants and normal adults following a custard meal at 1 gram protein per kilogram body weight.

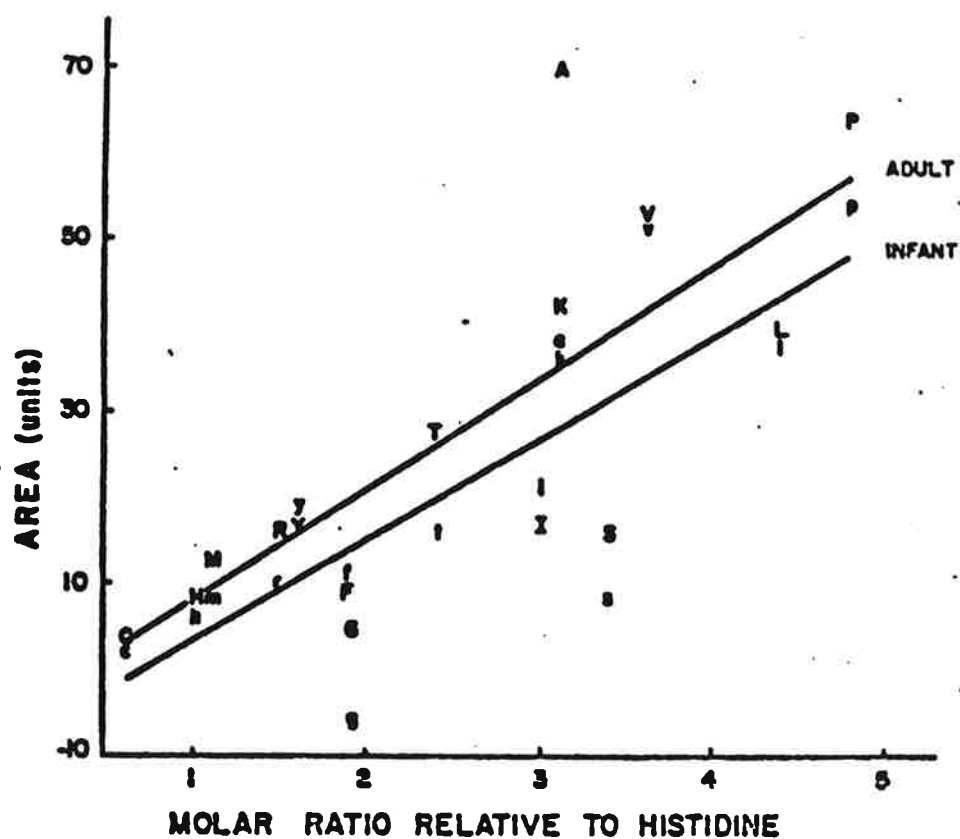


Figure 2. Area under the curve determined from aminograms following a high protein meal (milk-egg custard) as a function of molar ratios of individual amino acids relative to histidine in the meal.