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A Study on the Palatability of Foodstuff

– In particular, on the interrelationship between palatability, buffer action and phosphorus content of foodstuff –

Kyu Han Lee

Dept. of Food and Nutrition, College of Liberal Arts and Sciences, Dankook University.

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食品의 呈味性에 관한 硏究

– 특히 食品의 呈味性에 대하여 燐含量과 그의 緩衝作用에 관한 關係 –

李 圭 漢

단국대학교 문리과대학 식품영양학과

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Abstract

In order to verify any relationship between phosphorus content and buffer action vs. palatability of a foodstuff the present investigation was conducted on 28 items of foodstuff of both plant and animal and the followings are succinct report.

In general, foodstuffs of animal orgin contained more phosphorus than those of plant origin.

Foodstuffs with more phosphorus content were tended to have more buffer action.

The platability seems to be related with the capacity of buffer action.

Introduction

Taste of a food is not only closely related to the palatability but also, though not directly related to the nutritional value, to an increased apetite as well as digestion and absorption thus becoming one of the important factors for the quality of the foodstuff.

Of tastes, palatability which increases the apetite is specifically independent which can not be categorized into any of 4 basic tastes.

Many studies have been conducted on the compounds responsible for the palatability of foodstuffs thus far. With the initiation of report by Kodama[1] who found that an inosinic acid or 5'-mononucleotide is responsible for the taste of dried bonite, Kuninaka[2] in 1960 reported that 5'-GMP and 5'-XMP are as effective as 5'-IMP for the palatability. Ogata[3] also pointed out that d-IMP and d-GMP, both derivatives of nucleotide are responsible for palatability. Pointing out that purine ring is not neccessarily related to palatability, Huang[4] reported that 5'-amino-4-imidazol carboxamide ribotide (AICAR) and 5'-amino-4-imidazol ribotide (SAICAR) are also responsible for the palatability. Comparing the taste of 5'-IMP and 5'-GMP vs. monosodium glutamate (MSG) Shimazone[5] found that 5'-mononucleotides are superior than MSG and that a combination of a small amount of either 5'-IMP or 5'-GMP with MSG has a synergetic action on the

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palatability. These were further confirmed bv the works of Tidus[6], Fujida[7], Kassemsarn[8] and Saito[9].

Lee et al.[10] found that compounds responsible for the palatability of Kimchi (so called pickled vegetable by westerner) are free amino acids and 5'-mononucleotides, degredients of nucleic acids. Lee et al.[11] further reported that free amino acids including glutamic acid, with a good taste, lysine and alanine with sweet taste and leucine, with a little bitter taste produce a unique taste for semidried, yellow tailrunner.

However, almost no report is avaible as to the interrelationship between the buffer action and phosphorus content of foodstuff. Only Itamura and Umeta[12] reported that buffer action strengthens and prolongs taste.

Therefore, in order to determine any possible relationship between the content of phosporus and buffer action vs. palatability of foodstuffs, the author conducted a series of experiment on 10 items of 2 kinds of plant origin foodstuff, 16 items of 4 species of animal origin and 2 items of artificial condiment as well as distilled water and saline solution and the following findings are hereby reported.

Materials and Methods

Items of foodstuff investigated between 15 September and 15 November 1982 were as follows.

Beef
Pork
Chicken
Anchovy Extract
Shrimp, Fresh
Alaskan Pollack, Frozen
Squid, Fresh
Solen, Fresh
Short-necked Clam
Corb Shell
Cockle
Top Shell
Oyster
Arkshell, Sea-mussel, Fresh
Bovine Milk
Human Milk
Perilla Leaf
Chinese Cabbage
Cabbage
Lettuce
Soybean Sprout
Mungbean Sprout
Braken
Jaksul Tea
Sulrock Tea
Sanyangbanya Tea
Soybean Paste, Korean
Soybean Paste, Japanese
Distilled Water
1% – Saline Solution

Preparation of sample

Samples of vegetable, fruit, meat, fish and dried fish were sliced, weighed to about 40g, immersed to 500ml volumetric flask and messed up with distilled water. The samples were heated so that the total volume reached to 150ml which subsequently was filtered. The operation was repeated thrice and the filtrates were combined for further examination.

Market milk produced from 3 months of gestation was selected for the examination.

Exactly 2g each of sample teas were placed in 100ml volumetric flask, messed up with water of 100℃, left to ambiant temperature for 5 minutes and filtered to be used as samples.

Exactly 50g of each artificial condiment were ground, put into 500ml volumetric flask, messed up to be 10% solution with distilled water and 5 minutes after the commencement of boiling they were filtered and the filtrates were designed to be the samples.

With a slow addition of 0.2ml of 0.1 N-NaOH to 35ml of sample changes in pH were measured with the aid of TOD Digital pH Meter (Model HM-188). A similar operation was carried out with the addition of 0.1 N-HCl.

The quantification of phosphorus was carried out according to the method of molibden blue spectrophotometer[13].

Palatability test

A statistical score test on the palatability was conducted and the result was analyzed by Chi-square test.

Results and Discussion

The results of phosphorus content in 100g of sa-

mple as prepared as above for 30 items of popular foodstuffs are complied as in Table I.

Table I. Content of Phosphorus and pH of Sample

Food Item	Phosphorus Content (mg/100g)	pH
Beef	143	6.65
Pork	205	6.42
Chicken	265	6.22
Anchovy Extract	102	6.04
Shrimp, Fresh	1.102	8.67
Alaskan Pollack, Frozen	286	6.87
Squid, Fresh	206	6.68
Solen, Fresh	282	6.66
Short-necked Clam	76	6.77
Corb Shell	82	6.70
Cockle	255	6.52
Top Shell	120	8.24
Oyster	113	6.04
Arkshell, Sea-Mussel, Fresh	199	6.09
Bovine Milk	154	6.70
Human Milk	23	6.68
Perilla Leaf	203	6.00
Chinese Cabbage	63	5.48
Cabbage	31	5.66
Lettuce	27	5.86
Soybean Sprout	60	6.06
Mungbean Sprout	56	6.11
Braken	53	5.96
Jaksul Tea	363	6.50
Sulrock Tea	361	6.48
Sanyangbanya Tea	353	5.80
Soybean Paste, Korean	140	5.22
Soybean Paste, Japanese	195	5.40
Distilled Water	-	6.94
1%-Saline Solution	-	6.26

Generally, except teas, foodstuffs origin of plant contained several fold more phosphorus than those of animal origin. The high content of phosphorus of teas such as Jaksul, Sulrock, Sanyangbanya together with anchovy extract is considered to be due to dehydration. Perilla leaf contained a far greater amount of phosphorus than other vegetable and fruit whereas short-necked clam and corb shell had a considerablly lower content of this element than other shell fishes; fermented foodstuffs of plant origin contained as much phosphorus as those of animal origin whereas no difference was detectable between foodstuffs originated from vegetable and fruit.

The comparable results of buffer action of soybean paste Korean type, Japanese type and the saline solution are compiled in Fig. 1.

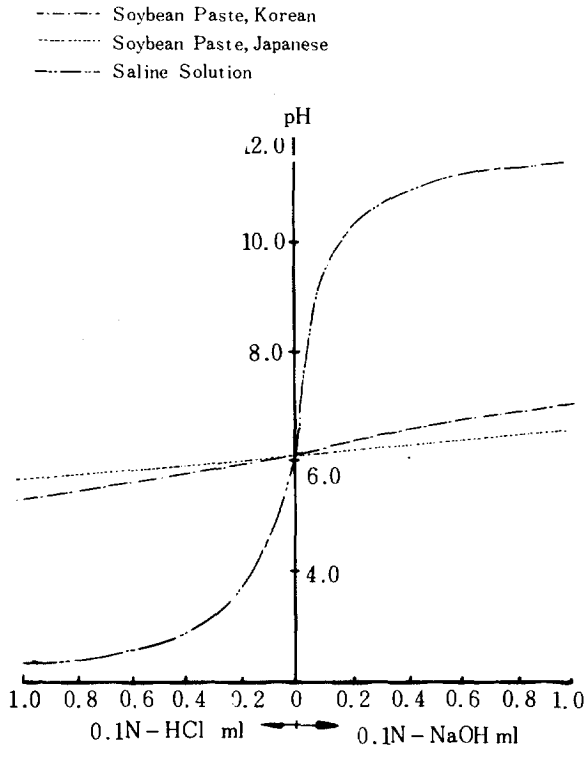

Fig. 1. Buffer action of soybean pastes Korean and Japanese type and saline solution.

Soybean pastes of both Korean and Japanese types were found to have superior buffer action than the saline solution as can be seen in Fig. 1. Comparison of the buffer action demonstrates that soybean paste Japanese type is stronger than the Korean counterpart and this is the case of phosphorus content which is further substantialized by figures in Table I. These are further statistically confirmed as is seen in Table II.

In this table A indicates the exellent flavour; B, good; C, mediocre; D, barely acceptable. The palatability is diminished by the order of soybean paste Japanese, the Korean counterpart and saline solution.

The buffer action of braken, mungbean sprout

and soybean sprout was compared as is in Fig. 2.

Table II. Panel Test for Palatability

	Soybean Paste, Korean	Soybean Paste, Japanese	Saline Solution	Total
A	9	15	0	24
B	8	8	0	16
C	10	6	0	16
D	3	1	30	34
Total	30	30	30	90
Score	2	1	3	

χ^2-test, $\chi^2$6df (0.005)=18.5, χ^2=77.9, $p<0.005$

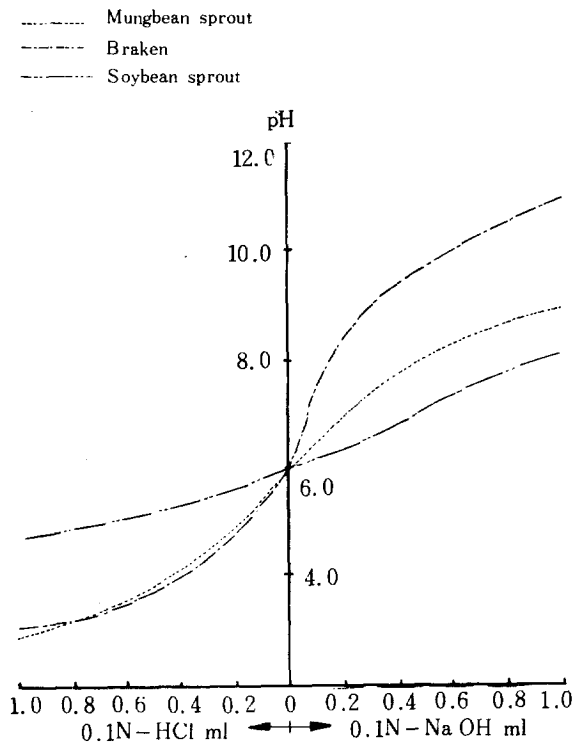

Fig. 2. Buffer action of braken mungbean sprout and soybean sprout.

The increasing order of buffer action is from braken to mungbean and soybean sprouts. Furthermore, 100g of soybean sprout contained 60mg of phosphorus whereas mungbean, 56mg followed by braken with 53mg. The palatability of these foodstuffs was statistically compiled in Table Ⅲ. It can be reasoned that the higher in phosphorus content of a foodstuff as is the case of artificial condiment, so is the palatability.

Table III. Panel Test for Palatability

	Braken	Boybean Sprout	Mungbean Sprout	Total
A	3	7	4	14
B	10	17	14	41
C	14	4	8	26
D	3	2	4	9
Total	30	30	30	90
Score	3	1	2	

χ^2-test, $\chi^2$6df ((0.05)=12.6, χ^2=10.17, N. S.

Perilla leaf contained 203mg of phosphorus per 100g followed by Chinese cabbage with 63mg of this substance, cabbage with 31mg and lettuce with 27mg as is seen in Table I. The buffer action of these foodstuffs is compiled in Figure 3. The palatability of these foodstuffs seems to augment in function of their phosphorus content.

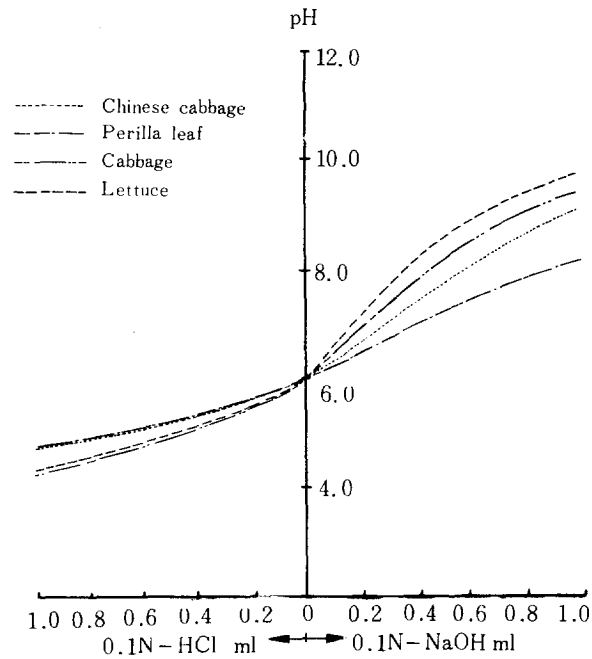

Fig. 3. Buffer action of Chinese cabbage, perilla leaf, cabbage and lettuce

The result of panel test for palatabilty of these foodstuffs is compiled as in Table IV.

The palatability diminished in these foodstuffs in function of their buffer action though not statistically significant as demonstrated by Chi-square test.

Table IV. Panel Test of Palatability for Chinese Cabbage, Cabbage, Perilla Leaf and Lettuce

	Chinese Cabbage	Cabbage	Perilla Leaf	Lettuce	Total
A	7	4	9	5	25
B	14	13	16	10	53
C	7	12	4	13	36
D	2	1	1	2	6
Total	30	30	30	30	120
Score	2	3	1	4	

x^2 – test, $x^2 9df\ (0.05) = 16.9$, $x^2 = 10.48$, N. S

Arkshell or sea-mussel contained 199mg of phosphorus per 100mg in contrast to oyster with 113 mg and these facts are coincide with their buffer action.

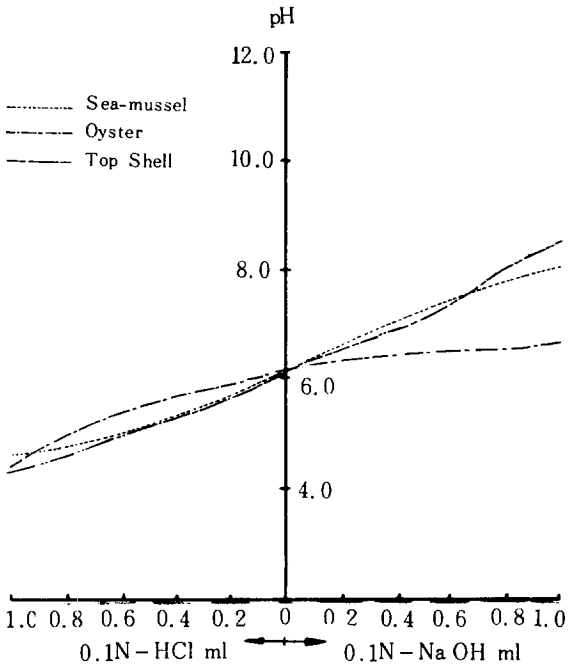

Fig. 4. Buffer action of sea-mussel, oyster and top shell

The statistical analysis by Chi-square method of these foodstuffs are summerised as in Table V.

The palatability diminished in the order of oyster, sea-mussel and top shell though the significance is not notable in statistical term. One thing to be remarked, despite the fact that top shell contained more phosphorus than sea-mussel, both

Table V. Panel Test of Palatability for Sea-mussel, Oyster and Top Shell.

	Oyster	Top Shell	Sea-mussel	Total
A	7	9	8	24
B	12	16	13	41
C	7	3	6	16
D	4	2	3	9
Total	30	30	30	90
Score	3	1	2	

$x^2 - test,\ x^2 6df\ (0.05) = 12.6\ x^2 = 3.2, N. S$

palatability and buffer action turned out to be contrary.

As can be seen in Table I, chicken had 265 mg per 100g, or the heighest, followed by beef with 145mg per 100g or the lowest. The buffer action of these foodstuffs is complied in Figure 5.

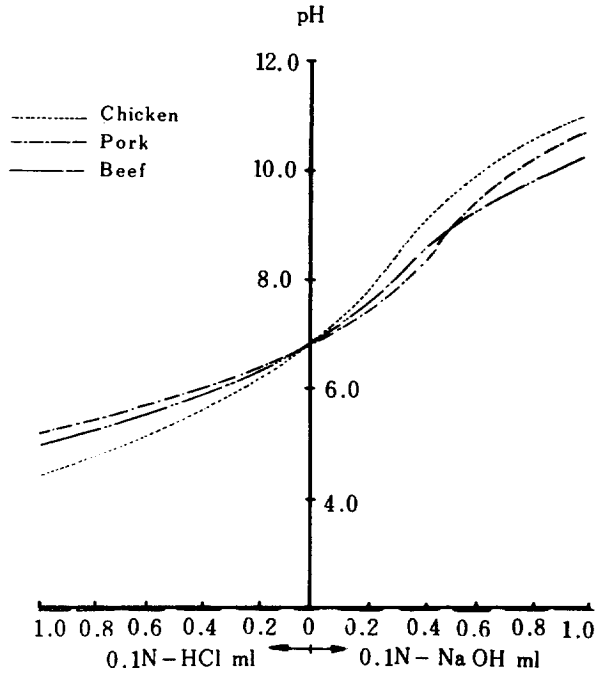

Fig. 5. Buffer action of chicken, pork and beef

In Figure 5 and other figure the phosphorus content of meat and the buffer action, as far as meat is concerned, do not tend to coincide. The panel test of palatability of these meats is summerized as in Table VI.

Table VI. Panel Test of Palatability of Meats

	Pork	Beef	Chicken	Total
A	9	11	8	28
B	12	13	10	35
C	5	4	8	17
D	4	2	4	10
Total	30	30	30	90
Score	2	1	3	

χ^2-test, $\chi^2$6df (0.05)=12.6, χ^2=3.4, N.S

In general, it can be assumed that meats with greater buffer action demonstrate a superior palatability.

As is seen in Table I, anchovy extract contained 1,102mg per 100grams; frozen Alaskan pollack, 286mg; squid, 206mg and shrimp, 168mg. The higher content of phosphorus of extractable anchovy seems due to its driness. The buffer action of these foodstuffs of marine origin is compiled in Figure 6.

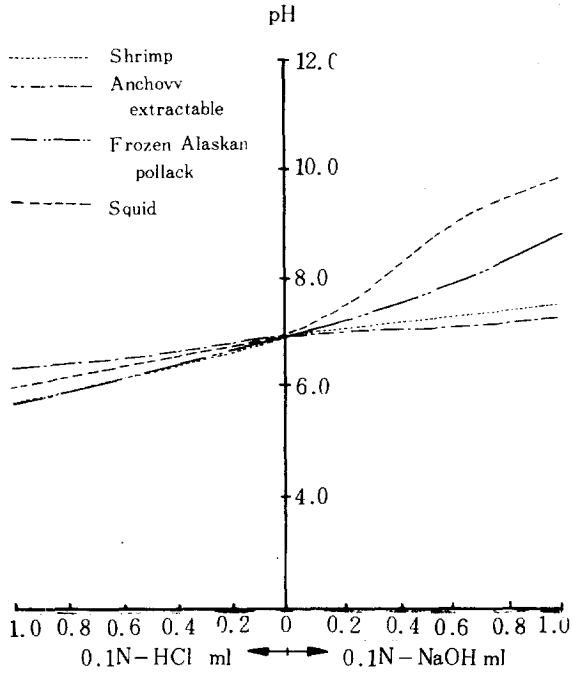

Fig. 6. Buffer action of shrimp, anchovy extractable, frozen Alaskan pollack and squid

The buffer action seems to be parell to the content of phosphorus, the exception being shrimp, the buffer action of shrimp was found to be superior than that of frozen Alaskan pollack or squid despite their phosphorus content. Otherwise no remarkable difference was detected among the samples. However statistically significant differences were noted among them as is seen in Table VII.

Table VII. Panel Test of Palatability for Shrimp, Alaskan Pollack, Anchovy and Squid.

	Shrimp	Anchovy	Alaskan Pollack	Squid	Total
A	8	10	1	7	26
B	13	16	3	10	42
C	7	2	14	9	32
D	2	2	12	4	20
Total	30	30	30	30	120
Score	2	1	4	3	

χ^2-test, χ^2 9df (0.005)=23.6 χ^2=38.63, $p<0.005$

The buffer action seems to be parallel to the palatability in general except in the case of squid and frozen Alaskan pollack. Solen had 282mg/100g followed by cockle with 255mg, corb shell with 82 mg, and short-necked clam with 76mg (see Table I). These foodstuffs demonstrated a relatively higher buffer action as is seen in Figure 7.

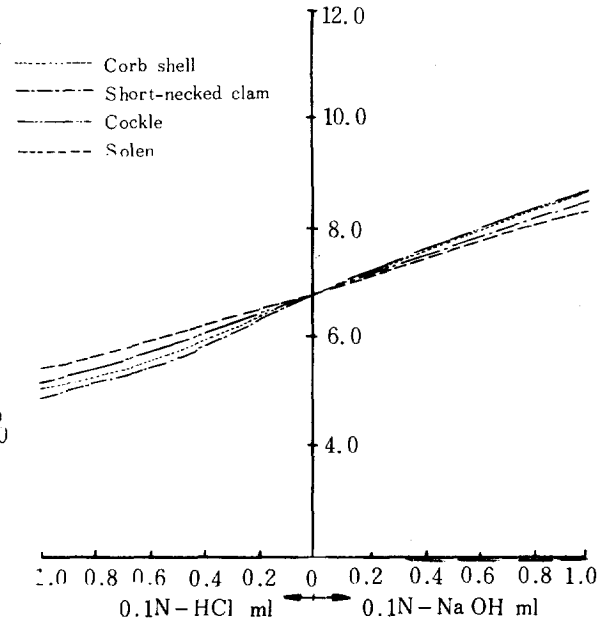

Fig. 7. Buffer action of corb shell, short-necked clam, cockel and solen

The results of panel test of palatability for above mentioned items are summerized as follow.

Table VIII. Panel Test for Palatability of Corb Shell, Short-necked Clam, Cockle and Solen

	Corb Shell	Solen	Short-necked Clam	Cockle	Total
A	5	5	4	5	19
B	12	12	10	9	43
C	11	10	13	15	49
D	2	3	3	1	9
Total	30	30	30	30	120
Score	1	2	3	4	

χ^2 - *test* $\chi^2 9df\,(0.05) = 16.9$, $\chi^2 = 3.06$, N. S

The bovine milk had 154mg of phosphorus per 100g in contrast to that of human with 23mg of this substance, about 7 times more (see Table II). Their buffer action was conspicuously superior when compared to that of distilled water as is evident in Figure 8.

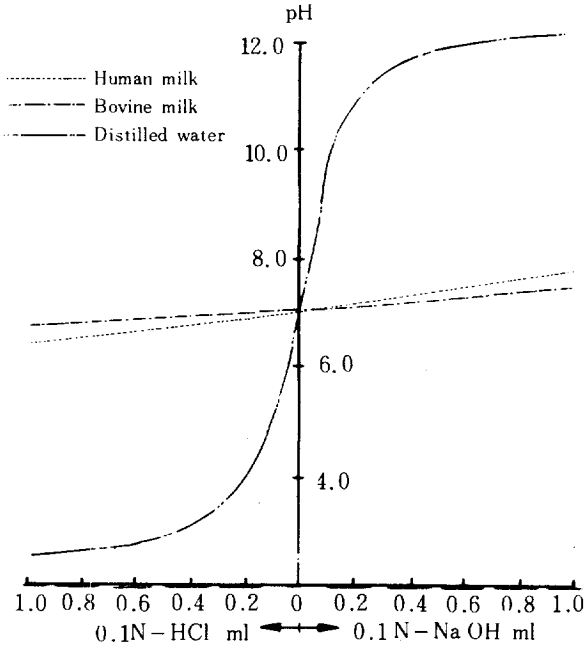

Fig. 8. Buffer action of human milk, bovine milk and distilled water

The buffur action was better with bovine milk than human milk but no statistical difference was obserbed between the two as observed in Table IX.

The Zaksulx tea contained 363mg of phosphorus per 100g, whilest, Sanyangbanya, 353mg in contrast (see Table I). The buffer action of these teas is seen in Figure 9.

Table IX. Panel Test of Palatability for Bovine Milk and Human Milk.

	Human Milk	Bovine Milk	Distilled Water	Total
A	9	12	0	21
B	12	16	0	28
C	8	2	30	40
D	1	0	0	1
Total	30	30	30	90
Score	2	1	3	

χ^2-test, $\chi^2 6df\,(0.005) = 18.5$ $\chi^2 = 60.5$, $p < 0.005$

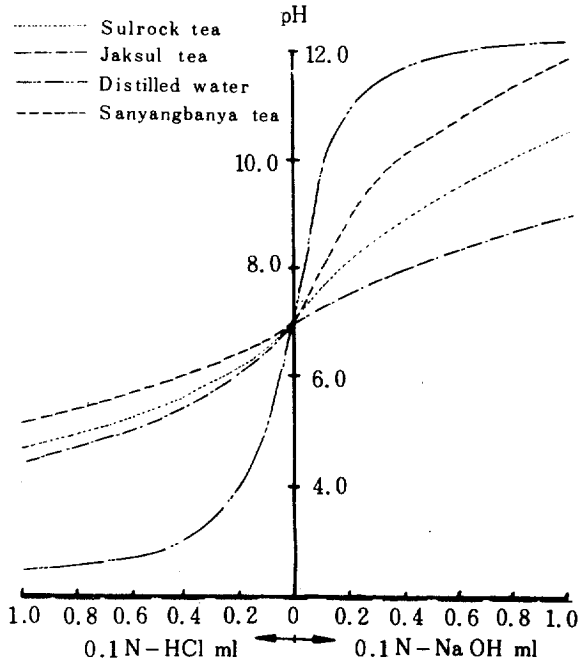

Fig. 9. Buffer action of various tea

It was found that the greater amount of phosphorus coincides with the greater palatability. The result of panel test for these foodstuffs is summerised as in Table X.

Table X. Panel Test of Palatability of Teas.

	Sulrock Tea	Jaksul Tea	Sanyangbanya Tea	Saline Solution	Total
A	7	9	6	0	22
B	12	14	12	0	38
C	9	5	9	2	25
D	2	2	3	28	35
Total	30	30	30	30	120
Score	2	1	3	4	

χ^2 - *test* $\chi^2 9df\,(0.005) = 23.6$, $\chi^2 = 83.15$, $p < 0.005$

The result was further confirmed by statistical treatment.

要 約

食品의 呈味性에 대하여 燐 含有量과 그의 緩衝作用에 관한 関係를 糾明하기 위하여 植物性 및 動物性 食品 28品目에 대한 実験 및 統計学的 処理를 한 바, 다음과 같은 結果를 얻었다.

一般的으로 動物性 食品이 植物性 食品보다 燐의 含有量이 높았으며, 또한 燐 含有量이 높은 食品이 더 큰 緩衝作用을 나타내였고, 아울러 거의 대부분 緩衝作用이 큰 食品은 呈味性이 良好하였다. 따라서 呈味性과 緩衝作用의 能力과 関聯되는 것으로 思料된다.

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