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**STUDIES ON FUNCTIONAL AND BIOCHEMICAL
PROPERTIES OF CAMEL MILK PROTEINS**

BY

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LIST OF ABBREVIATIONS

| | |
|-------------------|--|
| KDa: | Kilo Dalton |
| SDS-PAGE: | Sodium dodecyl sulphate polyacrylamide gel electrophoresis |
| PSI: | The protein solubility index |
| PDI: | The protein dispersibility index, |
| (CMWP) | Camel milk whey proteins |
| (CMCCP) | Camel milk casein co-precipitate |
| (FVS) | Foam volume stability |
| FS: | Foam stability |
| FC: | Foam capacity |
| EC: | Emulsifying Capacity |
| CMP: | Caseinomacropeptide |
| CMR: | CM separated from powdered from commercial milk by microfiltration/ diafiltration |
| <i>pI</i>: | Iso electric point |
| Cp: | Centipoise |
| WAC: | water absorption capacity |
| WPC: | whey proteins concentrate |
| MPC: | Milk protein concentrate |
| DH: | Degree of hydration |
| NA-CN: | Sodium Caseinate |
| (ESI) | Emulsion stability index |
| (EAI) | Emulsion activity index |

Table (5a): Effect of pH and protein concentration on the foaming capacity (FC) of HCl-casein prepared from camel and cow milks.

| milk | Casein concn (%) | pH 7.0 | | | pH 7.5 | | | pH 8.0 | | |
|------------|------------------|--------------------------|------------|-------------|--------------------------|------------|-------------|--------------------------|-----------------|-------------|
| | | Total volume | FC% | FE% | Total volume | FC% | FE% | Total volume | Volume increase | FE% |
| Camel | 0.25 | 251.00±1.53 ^a | 25.50±0.76 | 125.50±0.76 | 245.33±1.45 ^a | 22.67±0.73 | 122.67±0.73 | 254.67±1.45 ^a | 27.33±0.73 | 127.33±0.73 |
| | 0.50 | 264.67±2.03 ^b | 32.33±1.01 | 132.17±1.01 | 274.67±2.60 ^b | 37.33±1.30 | 137.33±1.30 | 284.00±0.58 ^b | 42.00±0.29 | 142.00±0.29 |
| | 0.75 | 279.33±1.20 ^c | 39.67±0.60 | 139.67±0.60 | 285.33±0.88 ^c | 42.67±0.44 | 142.67±0.44 | 304.67±2.03 ^c | 52.33±1.01 | 152.33±1.01 |
| | 1.00 | 296.00±2.08 ^d | 48.00±1.04 | 148.00±1.04 | 294.00±1.53 ^d | 47.00±0.76 | 147.00±0.76 | 329.67±2.60 ^d | 64.83±1.30 | 164.83±1.30 |
| | F-test | 122.433 ^{**} | | | 149.765 ^{**} | | | 303.075 ^{**} | | |
| | Sig. (p) | <0.001 | | | <0.001 | | | <0.001 | | |
| Cow | 0.25 | 249.67±1.45 ^a | 24.83±0.73 | 124.83±0.73 | 265.67±2.91 ^a | 32.83±1.45 | 132.83±1.45 | 275.33±1.45 ^a | 37.67±0.73 | 137.67±0.73 |
| | 0.50 | 276.33±2.19 ^b | 38.17±1.09 | 138.17±1.09 | 285.33±2.03 ^b | 42.67±1.01 | 142.67±1.01 | 310.67±2.91 ^b | 55.33±1.45 | 155.33±1.45 |
| | 0.75 | 290.33±1.45 ^c | 45.17±0.73 | 145.17±0.73 | 293.67±1.86 ^c | 46.83±0.93 | 146.83±0.93 | 314.67±1.45 ^b | 57.33±0.73 | 157.33±0.73 |
| | 1.00 | 301.67±2.19 ^d | 50.83±1.09 | 150.83±1.09 | 306.00±2.08 ^d | 53.00±1.04 | 153.00±1.04 | 334.67±2.60 ^c | 67.33±1.30 | 167.33±1.30 |
| | F-test | 146.011 ^{**} | | | 56.495 ^{**} | | | 125.280 ^{**} | | |
| | Sig. (p) | <0.001 | | | <0.001 | | | <0.001 | | |
| t-test (p) | | 0.864 (0.397) | | | 1.785 (0.088) | | | 1.473 (0.155) | | |

F: F test (ANOVA) T-test: Student t-test
 Different superscripts are significant: * Significant at p ≤0.05 ** Significant at p ≤0.01
 a-b-c-d: Means the same columns with different subscriptions are significantly different (p ≤0.05)

Table (5b): Effect of pH and protein concentration on the foaming capacity (FC) of HCl-casein prepared from camel and cow milks.

| Milk | Casein concn (%) | | pH 7.0 | | | pH 7.5 | | | pH 8.0 | | | F-test (p) |
|-------|------------------|------|---------------------|-------|--------|---------------------|-------|--------|---------------------|-------|--------|----------------------|
| | | | Total | FC% | FE% | Total | FC% | FE% | Total | FC% | FE% | |
| Camel | 0.25 | Mean | 251.00 ^a | 25.50 | 125.50 | 245.33 ^b | 22.67 | 122.67 | 254.67 ^a | 27.33 | 127.33 | 10.118* (0.012) |
| | | ±SE | 1.53 | 0.76 | 0.76 | 1.45 | 0.73 | 0.73 | 1.45 | 0.73 | 0.73 | |
| | 0.50 | Mean | 264.67 ^a | 32.33 | 132.17 | 274.67 ^b | 37.33 | 137.33 | 284.00 ^c | 42.00 | 142.00 | 24.990** (0.001) |
| | | ±SE | 2.03 | 1.01 | 1.01 | 2.60 | 1.30 | 1.30 | 0.58 | 0.29 | 0.29 | |
| | 0.75 | Mean | 279.33 ^a | 39.67 | 139.67 | 285.33 ^b | 42.67 | 142.67 | 304.67 ^c | 52.33 | 152.33 | 83.018** (<0.001) |
| | | ±SE | 1.20 | 0.60 | 0.60 | 0.88 | 0.44 | 0.44 | 2.03 | 1.01 | 1.01 | |
| | 1.00 | Mean | 296.00 ^a | 48.00 | 148.00 | 294.00 ^a | 47.00 | 147.00 | 329.67 ^b | 64.83 | 164.83 | 89.612** (<0.001) |
| | | ±SE | 2.08 | 1.04 | 1.04 | 1.53 | 0.76 | 0.76 | 2.60 | 1.30 | 1.30 | |
| Cow | 0.25 | Mean | 249.67 ^a | 24.83 | 124.83 | 265.67 ^b | 32.83 | 132.83 | 275.33 ^c | 37.67 | 137.67 | 39.798** (<0.001) |
| | | ±SE | 1.45 | 0.73 | 0.73 | 2.91 | 1.45 | 1.45 | 1.45 | 0.73 | 0.73 | |
| | 0.50 | Mean | 276.33 ^a | 38.17 | 138.17 | 285.33 ^b | 42.67 | 142.67 | 310.67 ^c | 55.33 | 155.33 | 54.853** (<0.001) |
| | | ±SE | 2.19 | 1.09 | 1.09 | 2.03 | 1.01 | 1.01 | 2.91 | 1.45 | 1.45 | |
| | 0.75 | Mean | 290.33 ^a | 45.17 | 145.17 | 293.67 ^a | 46.83 | 146.83 | 314.67 ^b | 57.33 | 157.33 | 68.101** (<0.001) |
| | | ±SE | 1.45 | 0.73 | 0.73 | 1.86 | 0.93 | 0.93 | 1.45 | 0.73 | 0.73 | |
| | 1.00 | Mean | 301.67 ^a | 50.83 | 150.83 | 306.00 ^a | 53.00 | 153.00 | 334.67 ^b | 67.33 | 167.33 | 60.720** (<0.001) |
| | | ±SE | 2.19 | 1.09 | 1.09 | 2.08 | 1.04 | 1.04 | 2.60 | 1.30 | 1.30 | |

F: F test (ANOVA)

Different superscripts are significant: * Significant at $p \leq 0.05$ ** Significant at $p \leq 0.01$ a-b-c-d: Means the same columns with different subscriptions are significantly different ($p \leq 0.05$)

Table (6a): Effect of pH and protein concentration on the foaming stability (FS) of HCl-casein prepared from camel and cow milks.

| Concentration (%) | | PH 7.0 | | | | | | | PH 7.5 | | | | | | | PH 8.0 | | | | | | |
|-------------------|-------|--|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------------------------|
| | | Volume of foam (ml) at 20°C after time, min. | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| Camel | 0.25 | 64.33 ±1.20 | 35.33 ±0.88 | 19.67 ±2.60 | 14.67 ±2.03 | 6.33 ±1.86 | 0.00 ±0.00 | 0.00 ^a ±0.00 | 85.67 ±1.20 | 66.00 ±2.08 | 39.67 ±1.45 | 24.00 ±1.53 | 14.67 ±2.60 | 5.33 ±1.45 | 0.00 ^a ±0.00 | 94.67 ±1.45 | 70.33 ±1.45 | 46.33 ±1.86 | 24.67 ±2.60 | 15.33 ±2.03 | 9.33 ±1.20 | 9.33 ^a ±1.76 |
| | 0.50 | 95.67 ±1.76 | 60.33 ±3.18 | 45.67 ±1.20 | 26.00 ±2.08 | 14.00 ±1.53 | 5.67 ±2.33 | 0.00 ^a ±0.00 | 104.67 ±1.45 | 84.67 ±2.03 | 58.33 ±2.19 | 41.00 ±2.08 | 26.67 ±2.19 | 14.00 ±2.08 | 6.00 ^b ±1.53 | 119.33 ±2.91 | 89.33 ±1.76 | 63.67 ±1.86 | 40.33 ±0.88 | 25.33 ±1.45 | 25.33 ±2.60 | 15.67 ^b ±1.20 |
| | 0.75 | 105.67 ±1.20 | 79.67 ±0.88 | 44.67 ±1.45 | 29.33 ±2.91 | 10.33 ±3.18 | 5.67 ±1.76 | 0.00 ^a ±0.00 | 124.00 ±1.53 | 95.33 ±2.03 | 80.33 ±1.45 | 54.00 ±2.08 | 34.67 ±2.03 | 21.00 ±1.53 | 9.67 ^b ±3.18 | 156.00 ±2.08 | 113.67 ±1.86 | 96.00 ±2.65 | 119.33 ±1.20 | 44.33 ±1.76 | 35.33 ±2.03 | 29.33 ^c ±1.20 |
| | 1.00 | 120.33 ±2.60 | 89.00 ±2.65 | 71.33 ±2.40 | 25.33 ±0.88 | 15.33 ±2.03 | 5.33 ±0.88 | 4.33 ^b ±1.20 | 140.67 ±1.76 | 105.33 ±0.88 | 84.00 ±1.53 | 65.67 ±2.33 | 49.33 ±2.33 | 34.67 ±2.03 | 19.67 ^c ±0.88 | 184.00 ±1.53 | 150.33 ±2.03 | 108.67 ±2.40 | 91.00 ±2.08 | 73.67 ±1.86 | 49.67 ±1.45 | 44.67 ^d ±2.60 |
| | F (p) | | | | | | | 13.000 ^{**} (0.002) | | | | | | | 20.583 ^{**} (<0.001) | | | | | | | 76.994 ^{**} (<0.001) |
| Cow | 0.25 | 94.33 ±1.20 | 75.33 ±0.88 | 65.67 ±1.76 | 55.67 ±2.33 | 54.67 ±2.60 | 50.00 ±1.15 | 45.00 ^a ±2.31 | 114.67 ±2.03 | 95.33 ±2.03 | 91.00 ±2.08 | 89.67 ±2.03 | 84.67 ±3.18 | 80.67 ±1.20 | 74.67 ^a ±0.88 | 125.67 ±1.20 | 95.33 ±2.33 | 95.67 ±1.76 | 90.67 ±2.91 | 84.67 ±2.65 | 79.00 ±2.08 | 75.33 ^a ±0.88 |
| | 0.50 | 128.33 ±0.88 | 104.67 ±0.88 | 95.67 ±1.20 | 86.00 ±1.53 | 81.33 ±2.96 | 79.33 ±2.91 | 75.33 ^b ±3.18 | 130.33 ±2.03 | 109.00 ±2.08 | 101.00 ±3.21 | 95.67 ±1.76 | 90.33 ±2.03 | 84.67 ±0.88 | 81.00 ^b ±1.53 | 154.67 ±10.33 | 109.00 ±0.88 | 130.67 ±2.33 | 123.33 ±2.19 | 90.33 ±2.33 | 114.67 ±2.03 | 110.33 ^b ±1.45 |
| | 0.75 | 134.67 ±2.03 | 110.33 ±2.03 | 105.67 ±2.33 | 93.00 ±2.52 | 91.00 ±2.08 | 84.33 ±2.33 | 80.67 ^b ±1.76 | 146.00 ±2.08 | 130.00 ±2.31 | 126.00 ±2.65 | 118.67 ±1.86 | 110.33 ±1.45 | 105.67 ±2.91 | 99.67 ^c ±1.45 | 169.00 ±3.21 | 130.00 ±2.33 | 145.67 ±2.91 | 134.33 ±2.33 | 110.33 ±2.08 | 124.67 ±2.60 | 119.33 ^c ±1.20 |
| | 1.00 | 146.00 ±2.08 | 124.33 ±2.33 | 114.33 ±1.76 | 110.67 ±2.91 | 105.67 ±1.20 | 103.33 ±2.73 | 100.67 ^c ±2.33 | 161.67 ±2.19 | 145.67 ±1.76 | 139.33 ±3.48 | 134.67 ±2.03 | 130.67 ±1.76 | 125.67 ±2.33 | 124.67 ^d ±2.03 | 205.67 ±2.91 | 145.67 ±2.19 | 176.00 ±1.53 | 171.33 ±2.96 | 130.67 ±1.53 | 164.67 ±0.88 | 160.67 ^d ±1.76 |
| | F (p) | | | | | | | 88.350 ^{**} (<0.001) | | | | | | | 215.905 ^{**} (<0.001) | | | | | | | 661.149 ^{**} (<0.001) |
| t (p) | | | | | | | | 12.119 ^{**} (<0.001) | | | | | | | 13.622 ^{**} (<0.001) | | | | | | | 9.095 ^{**} (<0.001) |

F: F test (ANOVA)

T-test: Student t-test

Different superscripts are significant: * Significant at $p \leq 0.05$ ** Significant at $p \leq 0.01$ a-b-c-d: Means the same columns with different subscriptions are significantly different ($p \leq 0.05$)

Table (6b): Effect of pH and protein concentration on the foaming stability (FS) of HCl-casein prepared from camel and cow milks.

| Concentration (%) | | PH 7.0 | | | | | | | PH 7.5 | | | | | | | PH 8.0 | | | | | | | F (p) | |
|-------------------|------|--|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------------|---------------------------------------|--|
| | | Volume of foam (ml) at 20°C after time, min. | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | | |
| Camel | 0.25 | 64.33 ±1.20 | 35.33 ±0.88 | 19.67 ±2.60 | 14.67 ±2.03 | 6.33 ±1.86 | 0.00 ±0.00 | 0.00 ^a ±0.00 | 85.67 ±1.20 | 66.00 ±2.08 | 39.67 ±1.45 | 24.00 ±1.53 | 14.67 ±2.60 | 5.33 ±1.45 | 0.00 ^a ±0.00 | 94.67 ±1.45 | 70.33 ±1.45 | 46.33 ±1.86 | 24.67 ±2.60 | 15.33 ±2.03 | 9.33 ±1.20 | 9.33 ^b ±1.76 | 28.000 ^{**} (0.001) | |
| | 0.50 | 95.67 ±1.76 | 60.33 ±3.18 | 45.67 ±1.20 | 26.00 ±2.08 | 14.00 ±1.53 | 5.67 ±2.33 | 0.00 ^a ±0.00 | 104.67 ±1.45 | 84.67 ±2.03 | 58.33 ±2.19 | 41.00 ±2.08 | 26.67 ±2.19 | 14.00 ±2.08 | 6.00 ^b ±1.53 | 119.33 ±2.91 | 89.33 ±1.76 | 63.67 ±1.86 | 40.33 ±0.88 | 25.33 ±1.45 | 25.33 ±2.60 | 15.67 ^c ±1.20 | 49.618 ^{**} (<0.001) | |
| | 0.75 | 105.67 ±1.20 | 79.67 ±0.88 | 44.67 ±1.45 | 29.33 ±2.91 | 10.33 ±3.18 | 5.67 ±1.76 | 0.00 ^a ±0.00 | 124.00 ±1.53 | 95.33 ±2.03 | 80.33 ±1.45 | 54.00 ±2.08 | 34.67 ±2.03 | 21.00 ±1.53 | 9.67 ^b ±3.18 | 156.00 ±2.08 | 113.67 ±1.86 | 96.00 ±2.65 | 119.33 ±1.20 | 44.33 ±1.76 | 35.33 ±2.03 | 29.33 ^c ±1.20 | 58.010 ^{**} (<0.001) | |
| | 1.00 | 120.33 ±2.60 | 89.00 ±2.65 | 71.33 ±2.40 | 25.33 ±0.88 | 15.33 ±2.03 | 5.33 ±0.88 | 4.33 ^a ±1.20 | 140.67 ±1.76 | 105.33 ±0.88 | 84.00 ±1.53 | 65.67 ±2.33 | 49.33 ±2.33 | 34.67 ±2.03 | 19.67 ^b ±0.88 | 184.00 ±1.53 | 150.33 ±2.03 | 108.67 ±2.40 | 91.00 ±2.08 | 73.67 ±1.86 | 49.67 ±1.45 | 44.67 ^c ±2.60 | 138.160 ^{**} (<0.001) | |
| Cow | 0.25 | 94.33 ±1.20 | 75.33 ±0.88 | 65.67 ±1.76 | 55.67 ±2.33 | 54.67 ±2.60 | 50.00 ±1.15 | 45.00 ^a ±2.31 | 114.67 ±2.03 | 95.33 ±2.03 | 91.00 ±2.08 | 89.67 ±2.03 | 84.67 ±3.18 | 80.67 ±1.20 | 74.67 ^b ±0.88 | 125.67 ±1.20 | 95.33 ±2.33 | 95.67 ±1.76 | 90.67 ±2.91 | 84.67 ±2.65 | 79.00 ±2.08 | 75.33 ^b ±0.88 | 130.694 ^{**} (<0.001) | |
| | 0.50 | 128.33 ±0.88 | 104.67 ±0.88 | 95.67 ±1.20 | 86.00 ±1.53 | 81.33 ±2.96 | 79.33 ±2.91 | 75.33 ^a ±3.18 | 130.33 ±2.03 | 109.00 ±2.08 | 101.00 ±3.21 | 95.67 ±1.76 | 90.33 ±2.03 | 84.67 ±0.88 | 81.00 ^a ±1.53 | 154.67 ±10.33 | 109.00 ±0.88 | 130.67 ±2.33 | 123.33 ±2.19 | 90.33 ±2.33 | 114.67 ±2.03 | 110.33 ^b ±1.45 | 72.740 ^{**} (<0.001) | |
| | 0.75 | 134.67 ±2.03 | 110.33 ±2.03 | 105.67 ±2.33 | 93.00 ±2.52 | 91.00 ±2.08 | 84.33 ±2.33 | 80.67 ^a ±1.76 | 146.00 ±2.08 | 130.00 ±2.31 | 126.00 ±2.65 | 118.67 ±1.86 | 110.33 ±1.45 | 105.67 ±2.91 | 99.67 ^b ±1.45 | 169.00 ±3.21 | 130.00 ±2.33 | 145.67 ±2.91 | 134.33 ±2.33 | 110.33 ±2.08 | 124.67 ±2.60 | 119.33 ^c ±1.20 | 168.217 ^{**} (<0.001) | |
| | 1.00 | 146.00 ±2.08 | 124.33 ±2.33 | 114.33 ±1.76 | 110.67 ±2.91 | 105.67 ±1.20 | 103.33 ±2.73 | 100.67 ^a ±2.33 | 161.67 ±2.19 | 145.67 ±1.76 | 139.33 ±3.48 | 134.67 ±2.03 | 130.67 ±1.76 | 125.67 ±2.33 | 124.67 ^b ±2.03 | 205.67 ±2.91 | 145.67 ±2.19 | 176.00 ±1.53 | 171.33 ±2.96 | 130.67 ±1.53 | 164.67 ±0.88 | 160.67 ^c ±1.76 | 216.000 ^{**} (<0.001) | |

F: F test (ANOVA)

t-test: Student t-test

Different superscripts are significant: * Significant at $p \leq 0.05$ ** Significant at $p \leq 0.01$ a-b-c-d: Means the same columns with different subscriptions are significantly different ($p \leq 0.05$)

Table (7a): Effect of pH and protein concentration on the foaming capacity (FC) of casein co-precipitates prepared from camel and cow milks.

| milk | Concentration (%) | pH 7.0 | | | pH 7.5 | | | pH 8.0 | | |
|------------|-------------------|---------------------------------|------------|--------------|---------------------------------|------------|-------------|--------------------------------|------------|-------------|
| | | Total volume (ml) | FC% | FE% | Total volume (ml) | FC% | FE% | Total volume (ml) | FC% | FE% |
| Camel | 0.25 | 220.33±1.45 ^a | 10.17±0.73 | 110.17±0.73 | 223.67±2.40 ^a | 11.83±1.20 | 111.83±1.20 | 239.33±1.20 ^a | 19.67±0.60 | 119.67±0.60 |
| | 0.50 | 236.00±1.53 ^b | 18.00±0.76 | 118.00±0.76 | 240.33±2.60 ^b | 20.17±1.30 | 120.17±1.30 | 260.00±3.46 ^b | 30.00±1.73 | 130.00±1.73 |
| | 0.75 | 240.67±2.33 ^b | 20.33±1.17 | 120.17±1.30 | 251.67±2.19 ^c | 26.00±1.26 | 125.83±1.09 | 270.67±1.76 ^c | 35.33±0.88 | 135.33±0.88 |
| | 1.00 | 258.33±2.19 ^c | 29.17±1.09 | 129.17±1.09 | 264.67±2.60 ^d | 32.33±1.30 | 132.33±1.30 | 284.67±2.03 ^d | 42.33±1.01 | 142.33±1.01 |
| | F-test | 66.717 ^{**} | | | 50.217 ^{**} | | | 70.681 ^{**} | | |
| | Sig. (p) | <0.001 | | | <0.001 | | | <0.001 | | |
| Cow | 0.25 | 245.33±2.60 ^a | 22.67±1.30 | 122.67±1.30 | 254.33±1.20 ^a | 27.17±0.60 | 127.17±0.60 | 266.33±2.40 ^a | 33.17±1.20 | 133.17±1.20 |
| | 0.50 | 259.67±1.45 ^b | 29.83±0.73 | 129.83±0.73 | 274.67±2.03 ^b | 37.33±1.01 | 137.33±1.01 | 281.33±1.86 ^b | 40.67±0.93 | 140.67±0.93 |
| | 0.75 | 276.67±2.19 ^c | 38.33±1.09 | 138.33±1.09 | 285.67±1.76 ^c | 42.83±0.88 | 142.83±0.88 | 294.67±1.45 ^c | 47.33±0.73 | 147.33±0.73 |
| | 1.00 | 289.33±2.33 ^d | 44.67±1.17 | 144.67±1.167 | 300.33±0.88 ^d | 50.17±0.44 | 150.17±0.44 | 299.00±1.53 ^c | 49.50±0.76 | 149.50±0.76 |
| | F-test | 77.665 ^{**} | | | 159.039 ^{**} | | | 63.501 ^{**} | | |
| | Sig. (p) | <0.001 | | | <0.001 | | | <0.001 | | |
| t-test (p) | | 4.384 ^{**} (<0.001) | | | 4.871 ^{**} (<0.001) | | | 3.373 ^{**} (0.003) | | |

F: F test (ANOVA) T-test: Student t-test
 Different superscripts are significant: * Significant at p ≤0.05 ** Significant at p ≤0.01
 a-b-c-d: Means the same columns with different subscriptions are significantly different (p ≤0.05)

Table (7b): Effect of pH and protein concentration on the foaming capacity (FC) of casein co-precipitates prepared from camel and cow milks.

| milk | Concentration (%) | | pH 7.0 | | | pH 7.5 | | | pH 8.0 | | | F-test (p) |
|-------|-------------------|------|---------------------|-------|--------|---------------------|-------|--------|---------------------|-------|--------|--------------------------|
| | | | Total volume (ml) | FC% | FE% | Total volume (ml) | FC% | FE% | Total volume (ml) | FC% | FE% | |
| Camel | 0.25 | Mean | 220.33 ^a | 10.17 | 110.17 | 223.67 ^a | 11.83 | 111.83 | 239.33 ^b | 19.67 | 119.67 | 33.083** (0.001) |
| | | ±SE | 1.45 | 0.73 | 0.73 | 2.40 | 1.20 | 1.20 | 1.20 | 0.60 | 0.60 | |
| | 0.50 | Mean | 236.00 ^a | 18.00 | 118.00 | 240.33 ^a | 20.17 | 120.17 | 260.00 ^b | 30.00 | 130.00 | 23.247** (0.001) |
| | | ±SE | 1.53 | 0.76 | 0.76 | 2.60 | 1.30 | 1.30 | 3.46 | 1.73 | 1.73 | |
| | 0.75 | Mean | 240.67 ^a | 20.33 | 120.17 | 251.67 ^b | 26.00 | 125.83 | 270.67 ^c | 35.33 | 135.33 | 51.825** (<0.001) |
| | | ±SE | 2.33 | 1.17 | 1.30 | 2.19 | 1.26 | 1.09 | 1.76 | 0.88 | 0.88 | |
| | 1.00 | Mean | 258.33 ^a | 29.17 | 129.17 | 264.67 ^a | 32.33 | 132.33 | 284.67 ^b | 42.33 | 142.33 | 36.177** (<0.001) |
| | | ±SE | 2.19 | 1.09 | 1.09 | 2.60 | 1.30 | 1.30 | 2.03 | 1.01 | 1.01 | |
| | 0.25 | Mean | 245.33 ^a | 22.67 | 122.67 | 254.33 ^b | 27.17 | 127.17 | 266.33 ^c | 33.17 | 133.17 | 23.786** (0.001) |
| | | ±SE | 2.60 | 1.30 | 1.30 | 1.20 | 0.60 | 0.60 | 2.40 | 1.20 | 1.20 | |
| Cow | 0.50 | Mean | 259.67 ^a | 29.83 | 129.83 | 274.67 ^b | 37.33 | 137.33 | 281.33 ^c | 40.67 | 140.67 | 38.218** (<0.001) |
| | | ±SE | 1.45 | 0.73 | 0.73 | 2.03 | 1.01 | 1.01 | 1.86 | 0.93 | 0.93 | |
| | 0.75 | Mean | 276.67 ^a | 38.33 | 138.33 | 285.67 ^b | 42.83 | 142.83 | 294.67 ^c | 47.33 | 147.33 | 24.300** (0.001) |
| | | ±SE | 2.19 | 1.09 | 1.09 | 1.76 | 0.88 | 0.88 | 1.45 | 0.73 | 0.73 | |
| | 1.00 | Mean | 289.33 ^a | 44.67 | 144.67 | 300.33 ^b | 50.17 | 150.17 | 299.00 ^b | 49.50 | 149.50 | 12.636** (0.007) |
| | | ±SE | 2.33 | 1.17 | 1.167 | 0.88 | 0.44 | 0.44 | 1.53 | 0.76 | 0.76 | |

F: F test (ANOVA)

Different superscripts are significant: * Significant at $p \leq 0.05$ ** Significant at $p \leq 0.01$ a-b-c-d: Means the same columns with different subscriptions are significantly different ($p \leq 0.05$)

Table (8a): Effect of pH and protein concentration on the foaming stability (FS) of casein co-precipitates prepared from camel and cow milks.

| Concentration (%) | | PH 7.0 | | | | | | | PH 7.5 | | | | | | | PH 8.0 | | | | | | | | | |
|-------------------|-------|--|----------------|----------------|----------------|----------------|----------------|-----------------------------|----------------------------------|-----------------|----------------|----------------|----------------|----------------|-----------------------------|-----------------|-----------------------------------|-----------------|----------------|----------------|----------------|-----------------------------|--|--|-----------------------------------|
| | | Volume of foam (ml) at 20°C after time, min. | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 0 | 5 | 10 | 15 | 20 | 25 | 30 | | | |
| Camel | 0.25 | 40.33 ±0.88 | 14.33 ±1.20 | 9.67 ±2.60 | 4.67 ±2.03 | 0.00 ±0.00 | 0.00 ±0.00 | 0.00 ±0.00 | 55.67 ±1.76 | 25.67 ±1.20 | 14.33 ±1.76 | 4.33 ±1.20 | 0.00 ±0.00 | 0.00 ±0.00 | 0.00 ±0.00 | 64.67 ±2.03 | 30.33 ±2.03 | 19.67 ±0.88 | 11.33 ±1.86 | 4.67 ±1.45 | 0.00 ±0.00 | 0.00 ±0.00 | | | |
| | 0.50 | 60.33 ±2.03 | 35.33 ±1.45 | 19.00 ±1.53 | 10.33 ±2.03 | 5.33 ±0.88 | 0.00 ±0.00 | 0.00 ±0.00 | 75.33 ±2.60 | 35.33 ±2.03 | 20.67 ±1.20 | 14.33 ±1.76 | 4.33 ±1.20 | 0.00 ±0.00 | 0.00 ±0.00 | 94.00 ±2.08 | 59.67 ±2.03 | 45.33 ±2.03 | 24.67 ±0.88 | 15.67 ±1.20 | 4.67 ±1.45 | 0.00 ±0.00 | | | |
| | 0.75 | 66.00 ±2.08 | 45.33 ±2.03 | 35.33 ±1.45 | 19.67 ±3.18 | 14.67 ±0.88 | 4.33 ±1.76 | 0.00 ±0.00 | 79.00 ±2.08 | 45.33 ±2.60 | 29.67 ±1.45 | 19.33 ±2.33 | 15.33 ±0.88 | 4.67 ±0.88 | 0.00 ±0.00 | 99.67 ±0.88 | 69.00 ±2.08 | 45.33 ±1.45 | 30.33 ±2.03 | 16.33 ±2.40 | 6.33 ±1.86 | 0.00 ±0.00 | | | |
| | 1.00 | 74.67 ±2.03 | 49.00 ±2.08 | 25.33 ±0.88 | 15.33 ±1.45 | 10.33 ±0.88 | 4.67 ±0.88 | 0.00 ±0.00 | 94.33 ±1.20 | 56.33 ±2.40 | 35.67 1.76 | 24.33 ±1.20 | 15.67 ±1.76 | 10.33 ±0.88 | 0.00 ±0.00 | 121.33 ±3.21 | 88.33 ±2.19 | 54.33 ±1.76 | 36.67 ±2.19 | 14.67 ±2.03 | 10.6 ±1.76 | 0.00 ±0.00 | | | |
| Cow | 0.25 | 65.67 ±1.20 | 45.67 ±1.76 | 40.33 ±2.60 | 34.33 ±2.33 | 30.67 ±2.91 | 24.67 ±1.45 | 23.00 ^a ±2.52 | 70.33 ±2.03 | 49.33 ±2.33 | 44.33 ±1.76 | 39.33 ±5.22 | 34.33 ±3.48 | 30.33 ±1.45 | 24.67 ^a ±0.88 | 84.33 ±1.20 | 64.67 ±2.03 | 60.33 ±0.88 | 54.67 ±1.76 | 50.33 ±1.45 | 46.33 ±1.86 | 38.67 ^a ±1.86 | | | |
| | 0.50 | 75.67 ±1.76 | 55.33 ±0.88 | 51.33 ±2.96 | 46.00 ±1.53 | 38.67 ±2.96 | 34.33 ±1.76 | 28.33 ^a ±2.19 | 94.33 ±2.33 | 71.00 ±2.08 | 64.67 ±2.60 | 61.00 ±2.91 | 59.67 ±1.45 | 54.33 ±1.20 | 50.33 ^b ±2.03 | 96.33 ±2.40 | 74.33 ±1.20 | 69.67 ±2.03 | 66.67 ±1.76 | 60.67 ±2.33 | 55.67 ±1.76 | 50.33 ^b ±0.88 | | | |
| | 0.75 | 95.67 ±2.33 | 69.67 ±2.03 | 65.33 ±3.18 | 59.67 ±0.88 | 54.00 ±2.08 | 50.33 ±2.03 | 44.67 ^b ±2.03 | 109.33 ±1.76 | 85.33 ±2.03 | 80.67 ±1.20 | 75.67 ±1.53 | 69.00 ±2.08 | 65.33 ±2.60 | 60.67 ^c ±1.20 | 122.00 ±2.52 | 96.00 ±2.08 | 90.33 ±2.03 | 84.33 ±2.60 | 81.00 ±2.08 | 79.00 ±2.08 | 75.33 ^c ±1.45 | | | |
| | 1.00 | 115.33 ±3.18 | 95.33 ±2.03 | 86.00 ±2.08 | 80.33 ±2.03 | 78.3 ±2.19 | 75.33 ±1.45 | 69.67 ^c ±2.60 | 128.33 ±3.79 | 105.33 ±0.88 | 98.67 ±2.96 | 95.67 ±2.33 | 95.67 ±1.20 | 91.6 ±2.19 | 84.33 ^d ±1.76 | 134.67 ±2.60 | 111.67 ±2.19 | 104.67 ±0.88 | 98.33 ±2.19 | 95.33 ±2.03 | 89.33 ±1.76 | 85.33 ^d ±0.88 | | | |
| | F (p) | | | | | | | | 79.938 ^{**} (<0.001) | | | | | | | | 258.980 ^{**} (<0.001) | | | | | | | | 262.891 ^{**} (<0.001) |
| t (p) | | | | | | | | | 7.441 ^{**} (<0.001) | | | | | | | | 8.474 ^{**} (<0.001) | | | | | | | | 11.001 ^{**} (<0.001) |

F: F test (ANOVA) T-test: Student t-test

Different superscripts are significant: * Significant at $p \leq 0.05$ ** Significant at $p \leq 0.01$ a-b-c-d: Means the same columns with different subscriptions are significantly different ($p \leq 0.05$)