

In general the amino acids most effective in potentiating germination by pressure were those which were also most effective as germinants, either alone or with inosine, at 1 atm. However, there were exceptions to this generalization, e.g. L-serine was not germinative in any of the systems tested at 1 atm. and yet strongly potentiated germination of spores of *Bacillus cereus* at 200 atm., and L-leucine, L-isoleucine and L-aspartic

Table 4. Potentiation of pressure germination of spores by amino acids

| Amino acid            | Germination (%)* following incubation† as indicated below |           |      |                               |                                     |                                   |                                     |
|-----------------------|---|-----------|------|-------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
|                       | <i>Bacillus cereus</i>                                    |           |      |                               | <i>Bacillus coagulans</i>           |                                   |                                     |
|                       | 1 atm. additions at                                       |           |      |                               |                                     |                                   |                                     |
|                       | 1 mM for 1 hr   | 10 mM for |      | 1 mM + 10 μM inosine for ½ hr | 200 atm. additions at 1 mM for ½ hr | 1 atm. additions at 1 mM for ½ hr | 200 atm. additions at 1 mM for ½ hr |
|                       | 1 hr  | 5 hr      |      |                               |                                     |                                   |                                     |
| Control (no addition) | 0   | 0         | 0    | 0                             | 0                                   | 0                                 | 0                                   |
| L-Alanine             | 80.5  | 100       | 100  | 100                           | 100                                 | 44                                | 92.5                                |
| L-α-Aminobutyric acid | 95  | 95        | 100  | 100                           | 99                                  | 0                                 | 90                                  |
| L-Cysteine            | 0   | 99        | 100  | 17                            | 96                                  | 0                                 | 2                                   |
| L-Phenylalanine       | 0   | 92        | 100  | 73                            | 100                                 | 0                                 | 0                                   |
| L-Glutamine           | 47  | 7         | 20   | 100                           | 88                                  | n.t.‡                             | n.t.                                |
| L-Threonine           | 6   | 0         | 42   | 95                            | 81                                  | 0                                 | 0                                   |
| L-Valine              | 2   | 1         | 42   | 60                            | 4                                   | 0                                 | 9                                   |
| L-Tryptophan          | 0   | 10        | 67   | 89                            | 88                                  | 0                                 | 0                                   |
| L-Methionine          | 0   | 19        | 20   | 67                            | 35                                  | 0                                 | 0                                   |
| β-Alanine             | 0   | 2.5       | 29   | 96                            | 100                                 | 0                                 | 1                                   |
| L-Leucine             | 0   | 5         | 22   | 86                            | 10                                  | 0                                 | 0                                   |
| L-Isoleucine          | 0   | 0         | 11   | 100                           | 19                                  | 0                                 | 0                                   |
| Glycine               | 0   | 0         | 4    | 100                           | 100                                 | 0                                 | 0                                   |
| L-Tyrosine            | 0   | n.t.      | n.t. | 63                            | 100                                 | 0                                 | 0                                   |
| L-Histidine           | 0   | 0         | 6    | 59                            | 37                                  | 0                                 | 0                                   |
| L-Aspartic acid       | 0   | n.t.      | n.t. | 68.5                          | 0                                   | 0                                 | 0                                   |
| L-Serine              | 0   | 0         | 0    | 0                             | 95.5                                | 0                                 | 0                                   |
| L-Lysine              | 0   | 0         | 5    | 0                             | 0                                   | 0                                 | 0                                   |
| L-Glutamic acid       | 0   | n.t.      | n.t. | 0                             | 0                                   | 0                                 | 0                                   |
| D-Alanine             | 0   | 47        | 78   | 100                           | 100                                 | 0                                 | 0                                   |
| D-Methionine          | 0   | 0         | 0    | 15                            | 5                                   | 0                                 | 0                                   |
| D-Tryptophan          | 0   | 0         | 0    | 2                             | 1                                   | 0                                 | 0                                   |
| D-Cysteine            |   |           |      |                               |                                     |                                   |                                     |
| D-Phenylalanine       |   |           |      |                               |                                     |                                   |                                     |
| D-Threonine           | n.t.  | n.t.      | n.t. | n.t.                          | 0                                   | 0                                 | 0                                   |
| D-Valine              |   |           |      |                               |                                     |                                   |                                     |
| D-Leucine             |   |           |      |                               |                                     |                                   |                                     |

\* Spores were activated before use (70°, 30 min.); germination was measured by recording percentage of phase-dark spores.

† Spores were incubated at 30° in 0.1 M-sodium phosphate (pH 8.0) plus the indicated amino acids.

‡ Not tested.

acid were less effective at 200 atm. than one would expect from their potentiation, with inosine, of germination at 1 atm.

Only in the case of alanine was the D-isomer about as effective as the L-isomer in potentiating pressure germination. Other D-isomers were relatively ineffective, even when the corresponding L-isomers were strong potentiators (e.g. cysteine, phenylalanine).