

# Folic acid - a micronutritive and promoter of growth for bacteria and fungus.

## A review.

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The recent interest in folic acid as a biostimulator in sewage treatment plants makes it necessary to give a more indepth literal review of the effect of this vitamin on microorganisms.

More than 50 years ago folic acid was discovered as a factor of growth for bacteria, and for over 40 years it has produced by synthesis. Recently folic acid was the object of several summarizing representations (50) (51) (48) (63) (73) (74) (76) (86) (87).

The interest which has recently been shown in this vitamin of the B-group by physicians and diet physiologists is due to two remarkable publications within a short time.

They both give a complete picture of folic acid from the view historical, in chemistry analysis and in biochemistry, and shows

its sigificance for nutritive physiology (84) (85).

Folic acid displays two characteristic mechanisms in action on microorganisms (48). Firstly it acts as a micronutrient on certain bacteria, and secondly it stimulates growth on microorganisms by its vitamin action (76). The whole enzym activity that could be sustained by the microorganisms cell is limited. Folic acid obviously enhances the switching off of some of the metabolic pathways, thus increasing the capacity for different metabolic processes so that the capacity to consume nutrients of whatever type may be increased.

The following is an alphabetic tabulated summary of those microorganisms for which folic acid is essentiel as a micro-nutrient or growth factor, according to literature:

More cultures could be found in the above cited publications and reviews.

It was ascertained in a number of publications that folic acid counteracts the antimicrobial effect of sulfonamides (10) (25)(49)(59), penicillins (32) and tetracyclines (30). Mutagens seem to be less effective in the presence of folic acid. Hyperbaric oxygen pressure presents another toxic effect on microorganisms for which folic acid was an inhibitor (49)(80).

Whereas most other vitamins which also are essential for microbial growth need to be present in relatively high concentrations, this is not neccessary for folic acid. Some nanograms per milliliter fermentation broth are all that is necessary to fullfil the effects described in this review (24) (30)(34)(46)(47)(55).

| Microorganism               | Literature  | Microorganismus             | Literature  |
|-----------------------------|---|-----------------------------|---|
| Acetobacter                 | [10][26][89]  | Nitrosomonas                | [90]  |
| Achromobacter               | [90]  | Norcadia                    | [90]  |
| Agrobacterium               | [35]  | Pediococcus cerevisiae      | [45][60][64][65][69][77]  |
| Alcalidines denitrificans   | [90]  | Propionibacteria            | [59]  |
| Bacillus coagulans          | [27]  | Propionibacterium jensenii  | [59]  |
| Bacillus stearothermophylus | [28] [29]   | Propionibacterium           |   |
| Bacillus subtilis           | [30]  | - pentosaceum               | [59]  |
| Candida                     | [37][75][81]  | Propionibacterium rubrum    | [59]  |
| Clostridium tetani          | [2]   | Pseudomonas                 | [52][70][79]  |
| Enterobacter aerogenes      | [48]  | Pseudomonas acidovorans     | [58]  |
| Escherichia coli            | [6][36][55][57][68][80]   | Pseudomonas aeruginosa      | [49]  |
| Flavobacterium              | [79]  | Pseudomonas fluorescens     | [90]  |
| Fusarium                    | [88]  | Pseudomonas stutzeri        | [58]  |
| Fusarium moniliforme        | [54]  | Rhizobium trifoli           | [61]  |
| Fusarium oxysporum          | [54]  | Rhizopus microsporus        | [66]  |
| Lactobacillus casei         | [1][3][5][7][8][9][11][14]<br>[15][16] [31][32][34][42]<br>[47][55][56][69][78][82] | Rhodotorula                 | [13][40]  |
| Lactobacillus delbrückii    | [15][17][39][67]  | Sacharomyces cerevisiae     | [44][62]  |
| Lactobacillus fermenti      | [16]  | Sporolactobacillus inulinus | [72]  |
| Lactobacillus leichmannii   | [7]   | Streptococcus avium         | [45]  |
| Leuconostoc                 | [12][16][19][20]  | Streptococcus faecalis      | [3][4][7][11][15][16]<br>[21][22][23][36][41]<br>[43][45][46][53][69] |
| Micrococcus                 | [90]  | Streptococcus -             |   |
| Mycobacterium               | [83]  | -thermophilus               | [36]  |
| Nitrobacter                 | [90]  | Staphylococcus aureus       | [24][25]  |

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