Modeling polyclonality and mutation in Microbal Enhanced Oil Recovery

A.Dehghan*
M.S MOAZEMI GOUDARZI
Young researchers and elite club, Damghan, Iran
Department of biology, Damghan Islamic Azad university, Damghan, Iran
*ashkaandehghaan@gmail.com

Abstract: MEOR is a method whitch ehance the oil recovery by changing the function or nature of micro organisms of oil reservoirs[1]. Problem faced is that the bacteria will variey in accordance with mutation occured because of outgoing longwave radiation of earth and earth's internal heat budgets and this will end up in unenhanced oil recovery[2] [3]. Modeling polyclonality and cell mutation can be extremely advantageous, for avoiding this condition. the subpopulations are not independent but are connected by mutational events transferring mutaited cells from cell population *i* to cell population *j* .

$$\frac{\partial \bar{\mathbf{c}}}{\partial \bar{t}} = \bar{\nabla} \cdot (D \bar{\nabla} \bar{\mathbf{c}}) + \rho \bar{\mathbf{c}} + T \bar{\mathbf{c}}$$

Initially, let us suppose there is a source of *u* mutaited cells that have mutated from healthy cells and can proliferate faster then the neighboring normal cells thereby starting to form a colony. We can think of *k* as a measure of the probability of *u* mutaited cells mutating to become the rapidly diffusing tumour cell population *v* Introduce the nondimensional variables
where $u0 = \int f(\mathbf{x}) d\,\mathbf{x}$, the total original cancer cell population.

$$\frac{\partial u}{\partial t} = \nabla^2 u + u - \alpha u \qquad \frac{\partial v}{\partial t} = \nu \nabla^2 v + \beta v + \alpha u$$

The parameter $\alpha = k/\rho 1 < 1$ is the proportion of the first subpopulation's growth lost to mutation.
Let us take the initial source of *u* tumour cells to be $u(x, 0) = \delta(x)$ and take $v(x, 0) = 0$. The *v* population diffuses faster than *u* so $v > 1$. The growth rate of the *u* population is larger than *v* so $\beta < 1$. The growth rate of *u* is much higher than the probability of mutation so $\alpha < 1$. The first solution can be solved separately from the *v* equation and has the solution

$$u(x, t) = \frac{1}{\sqrt{4\pi t}} \exp\left((1 - \alpha)t - \frac{x^2}{4t}\right)$$

Keywords: MEOR; outgoing longwave radiation of earth; earth's internal heat budgets

References

[1] Van Hamme, J.D., A. Singh, and O.P. Ward, Recent advances in petroleum microbiology. Microbiology and Molecular Biology Reviews, 2003. 67(4): p. 503

[2] Korenaga, J. (2011). Earth's heat budget: Clairvoyant geoneutrinos. Nature Geoscience, 4(9), 581–582.

[3] *Jacobowitz, Herbert; Soule, Harold V.; Kyle, H. Lee; House, Frederick B. (30 June 1984). "The Earth Radiation Budget (ERB) Experiment: An overview". Journal of Geophysical Research: Atmospheres.* ***89*** *(D4): 5021–5038*