Table 1. Physiological and Chemical Values of Buffalo Blood

Items	Unit	Range	Mean ± S.D.	C.V. %
Specific gravity	gm./ml.	1·05–1·07	1·058 ± 0·012	1
pH		7·35–7·6	7·45 ± 0·0382	0·5
Sedimentation-rate	mm./1 hr.	2–8	6·0 ± 1·65	29
Clotting time	min.	6–7·25	6·75 ± 0·065	1
Hæmoglobin	gm./100 ml.	11·04–15·18	12·98 ± 1·236	10
Hæmatocrit	percentage	38–52%	44·3 ± 3·028	7
Sugar	mgm./100 ml.	72–90	81·4 ± 3·411	4
Plasma proteins	gm./100 ml.	6·82–7·62	7·43 ± 0·266	4
Plasma non-protein nitrogen	mgm./100 ml.	25–42	36 ± 3·142	8
Plasma sodium	mgm./100 ml.	400–430	415 ± 6·53	2
Plasma calcium	mgm./100 ml.	9–11	10 ± 0·156	2
Plasma phosphorus	mgm./100 ml.	26–31	28 ± 1·032	3

content of sugar plasma proteins and phosphorus and low content of calcium and sodium.

The blood picture of the animal is a result of an interaction between environmental (mainly domestication) and hereditary factors. The blood picture of the Egyptian buffalo falls among that of the Kumeoni, Hariana and Dhanni breeds of the Indian buffalo reported by Kehar and Murty[1]. A comparative study of normal hæmatological values is of great significance in studying the origin and evolutionary trends of species and breeds; such studies are also of particular interest for practical animal husbandry in the tropics, since certain features may be correlated with heat tolerance, environmental stress and disease immunity.

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In vitro Production of Tropical Black Earth

The term 'grumusol' was proposed by Oaks and Thorp[1] for the dark-coloured clays which occur in many tropical and sub-tropical regions. Much is known concerning the chemistry[2,3], mineralogy[4] and fertility[5] of a number of these soils; but, as pointed out by Joffe[6], "the source of the black colour has been a kind of an enigma".

During the course of an investigation into the origin of the colour of Gold Coast black Akuse clay, the following experimental approach was adopted. Experimental pedology (the production of characteristic soil types under controlled laboratory conditions) is still a neglected section of soil science, and apart from the *in vitro* production of podsols[7] there has been scarcely any published work on this approach. The success met with here has prompted us to publish the results obtained, in order to indicate the potentialities of the method for studying tropical soil formation.

The three substrates used were kaolin (white), Bunso clay (yellow-red), and Akuse clay from which the organic matter had been removed by heating to 600° C. (yellowish-brown). 40-gm. samples of each of these substrates were placed in a series of 12-oz. bottles. These were then amended so that all possible combinations of five variable factors were represented.

The factors were: (1) Presence of readily-decomposable organic matter: (*a*) 3 per cent finely ground *Vetiveria* grass (dominant species on Akuse clay); (*b*) no plant material added. (2) Presence of an inoculum of black Akuse clay: (*a*) 1 ml. of a 1 : 5 soil suspension added; (*b*) no inoculum added. (3) pH: (*a*) adjusted to pH 5 with 2 N hydrochloric acid; (*b*) adjusted to pH 8 with 0·25 N sodium hydroxide. (4) Presence of excess calcium carbonate: (*a*) 5 per cent calcium carbonate added; (*b*) no calcium carbonate added. (5) Water content: (*a*) substrate kept permanently waterlogged; (*b*) substrate saturated with water and then left to dry out; alternation of anaerobic and aerobic conditions repeated throughout the course of the experiment.

The bottles were kept at room temperature (22–35° C.) and the results recorded after six weeks. No colour changes occurred in the amended kaolin; but in both the red Bunso clay and the mineralized Akuse clay there developed under certain conditions the characteristic grey colour associated with 'grumusols'.

There were four essential conditions for the development of this colour in the mineralized Akuse; namely, the presence of plant material, a soil inoculum, alkaline reaction and waterlogging. The addition of calcium carbonate, however, had no effect.

For the colour to develop in red Bunso clay, alkaline waterlogged conditions and the presence of plant material were again essential. An inoculum of Akuse clay was unnecessary, indicating that the native microflora of the ferruginous clay is able to induce the colour change if the soil conditions are favourable. In the absence of added calcium, the grey zone in Bunso clay was small and ill-defined, indicating that calcium was involved in the production of the colour and that the lack of a response to added calcium carbonate in mineralized Akuse was due to the high calcium status already existing in the soil.

Grumusols develop in warm regions with well-defined wet and dry seasons[1]. Our results indicate that the dark colour of these soils is due to the activity of anaerobic bacteria which develop in the alkaline, poorly drained montmorillonitic clays during the wet season. This confirms the hydrogenic origin of tropical black clays, as suggested by the work of Mohr[8] and del Villar[9].

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