# On the existance of non exposing functionals

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## Abstract

It has been shown in [1] that if E is a Separable Banach Space and $\ell_1$ embeds in E then there exists a norm on E, $f \in E^{**}$ and $\in > 0$ such that for every g in E with $\|g\| < \in$ , $f + g$ does not a Hahn its norm on $B_{E^*}$ the unit ball in $E^*$. Of course such $f + g$ cannot expose $B_{E^*}$.

In this paper we will show that if Y is any Banach Space that contains an isomorphic copy of $\ell_1$ then their exists a norm $|||\ |||$ on Y and an infinite dimensional subspace Z of $Y^{**}$ such that if $g \in Z$ , $g \neq 0$, then there is an $\in > 0$ such that $f + g$ does not expose $B_{Y^*}$ for any f in Y with $|||f||| \leq \in$ . Of course $B_{Y^*}$ here denotes the unit ball in $Y^*$ when Y is equipped with the new norm.

Given any Banach Space E, if E admits and equivalent norm, then unless otherwise stated, we shall keep denoting by $B_{E^*}$ the unit ball of $E^*$ corresponding to the new dual norm on $E^*$.

Before proving the new Eioned result, let us fix some notations:

If E is a Banach Space and $KE$, then we say that a point $x \in K$ is an exposed point if there is $f \in E^*$:

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$$f\ (x)\ >\ f\ (y) \qquad \forall\ y\ \in\ K\ ,\ y \neq x$$

in such case we say that f exposes K at x.

Note that if $x\ \in\ K$ is an exposed point then x is necessarily and extreme point of K since if:

$$x\ =\ \frac{y+z}{2} \qquad y,\ z\ \in\ K\ ,\ y \neq K$$

$$\begin{aligned} then:\ f\ (x) &= f\,\frac{(y+z)}{2} \\ &= \tfrac{1}{2} f\ (y) + \tfrac{1}{2} f\ (z) \\ &< \tfrac{1}{2} f\ (x) + \tfrac{1}{2} f\ (x) = f\ (x) \end{aligned}$$

a contrdiction.

By a face of a non-empty convex set K we mean a non-empty subset F of K such that if $x\ \in\ F,\ 0\ \leq\ t\ \leq\ 1$

$$x = ty + (1-t)\ z\ ,\ y,\ z\ \in\ K$$

then $y,\ z\ \in\ F$. If the set of extreme points of F and K are denoted by Ext (F), Ext (K) respectivily then it is clear that if $x\ \in\ Ext\ (F)$, then:

$$x\ \in\ Ext\ (K)$$

**Lemma (1.1):**

Let $(F_i)_{i\ \geq\ 1}$ be a sequence of Banach Spaces and let:

$$F = \overset{\infty}{\underset{i=1}{\oplus}} F_i = \left\{ x = (x_i)\ \in\ \prod_{i=1}^{\infty} F_i\ ;\ \|x\| = \sum_{i=1}^{\infty} \|x_i\|\ <\ \infty \right\}$$

$$F^* = \overset{\infty}{\underset{i=1}{\oplus}} F_i^* = \left\{ x^* = (x_i^*)\ \in\ \prod_{i=1}^{\infty} F_i^*\ ;\ \|x^*\| = snp_i \|x_i^*\| \right\}$$

then:

(i) $Ext\ (B_{F^*}) = \pi \infty\ _{i=1} Ext\ (B_{F_i^*})$

(ii) $\overline{Ext\ (B_{F^*})}^{W^*} = \pi \infty\ _{i=1} \overline{Ext\ (B_{F_i^*})}^{W^*}$

Proof:

To prove (i) we show that $x\ \in\ Ext\ (B_{F^*})$ iff:

$$x = (x_1,\ x_2,\ x_3,\ \ldots)\ ,\ x_i\ \in\ Ext\ (B_{F_i^*})\ \forall\ i$$

if $x \notin Ext\ (B_{F^*})$, but $x = (x_1,\ x_2,\ ...)$

with $x_i \in Ext\ (B_{F_i^*})\ \forall\ i$

then $x = \frac{y+z}{2}$

for some $y,\ z \in B_{F^*},\ y \neq z$

hence there is at least one index i such that: $z_i \neq y_i$

with $z_i,\ y_i \in B_{F_i^*}$

since $B_{F^*} = \pi \infty_{\ i=1} B_{F_i^*}$

But this means that $x_i = \frac{y_i+z_i}{2}$ a contradiction.

Hence $x \in Ext\ (B_{F^*})$ (1)

Now suppose $x \in Ext\ (B_{F^*})$ and $x = (x_1,\ x_2,\ ...)$

with $x_i \notin Ext\ (B_{F_i^*})$ for some i, then there are:

$y_i\ ,\ z_i \in B^{F_i^*}\ ,\ z_i \neq y_i$

and $x_i = \frac{y_i+z_i}{2}$

but then the elements:

$z = (x_1,\ x_2,\ ...,\ x_{i-1},\ z_i,\ x_{i+1},\ ...)$

$y = (x_1,\ x_2,\ ...,\ x_{i-1},\ y_i,\ x_{i+1},\ ...)$

are in $B_{F^*}$, with: $x = \dfrac{y+z}{2}$

a contradiction.

Hence $x_i \in Ext\ (B_{F_i^*})\ \forall$ (2)

From (1) and (2) part (i) is proved.

To prove (ii) first we show that:

$$(B_{F^*},\ W^*) = \prod_{i=1}^{\infty}(B_{F_i^*},\ W^*)$$

where $(B_{F^*},\ W^*)$ is the unit ball of $F^*$ in the $W^*$ topology.

Suppose $u^n = (u_i^n)$ in $B_{F^*}$ and $u^n \to u$ in $(B_{F^*},\ W^*)$.

Hence for every $x = (x_i)$ in F we have:

$< u^n, x > \to < u, x >$

or: $\sum_{i=1}^{\infty} u_i^n (x_i) \to \sum_{i=1}^{\infty} u_i (x_i)$

thus for $x = (0, 0, ..., x_i, 0, 0, ...)$ in F we have:

$u_i^n (x_i) \to u_i (x_i) \ in \ (B_{F_i^*}, W^*)$

which means that $u^n \to u \ in \ \prod_{i=1}^{\infty} (B_{F_i^*}, W^*)$

Conversely, suppose that: $u_i^n \to 0 \ in \ (B_{F_i^*} W^*)$

for every i, we show that: $u^n \to 0 \ in \ (B_{F^*}, W^*)$

Let $x = (x_i) \in B_F$, the for every $\in > 0$, there exists a natural number N:

$$\sum_{i=N+1}^{\infty} \|x_i n \leq \frac{\in}{2}$$

Now $| \sum_{i=1}^{\infty} u_i^n (x_i) ||| \leq \sum_{i=1}^{N} |u_{i.}^n (x_i) | + \sum_{i=N+1}^{\infty} |u_i^n (x_i) |$

$$\leq \sum_{i=1}^{N} |u_i^n (x_i) | + \sum_{i=N+1}^{\infty} \|u_i^n\| \|x_i\|$$

$$\leq \sum_{i=1}^{N} |u_i^n (x_i) | + \sum_{i=N+1}^{\infty} \|x_i\|$$

$$\leq \sum_{i=1}^{N} |u_i^n (x_i) + \frac{\in}{2}$$

by the fact that $u_i^n \to 0 \ in \ B \ (F_i^*, W^*), \ \forall i$

hence for each $i = 1, 2, 3, ..., N$ there is $\gamma_i$:

$|u_i^n (x_i) | < \frac{\in}{2N} \ for \ n \geq \gamma_i$

if we let $\gamma \geq \gamma_i$ for $i = 1, 2, ..., N$, then for $n >, \gamma$ we have:

$$\sum_{i=1}^{N} |u_i^n (x_j)| \leq \sum_{i=1}^{N} \frac{\in}{2N}$$

$$\leq \frac{\in}{2}$$

or simply $u^n \to 0 \ in \ (B_{F^*}, \ W^*)$

Henece by [6] we now have: $\pi_{i=1}^{\infty} \overline{Ext \ (B_{F_i^*})}^{W^*} = \overline{Ext \ (B_{F^*})}^{W^*}$

**Theorem 1.2 [2]**

There exits an equivalent norm on $\ell_1$ such that if E denotes $\ell^1$ with new norm, then we have:

$$\overline{Span}\left(\overline{Ext \ (B_{E^*})}^{W^*}\right) \neq E^*$$

**Lemma (1.3):**

There exists an equivalent norm on $\ell_1$ such that if E denotes $\ell^1$ equipped with the new norm, then:

$$\frac{E^*}{\overline{Span}\left(\overline{Ext \ (B_{E^*})}^{W^*}\right)}$$

is infinite dimensional.

Proof:

Write $I\!N = \cup_{i=1}^{\infty} N_i, \ N_i$ infinite and

$N_j \cap N_i = \phi, \ i \neq j$

then: $\ell_i \ (N) = \oplus_{i=1}^{\infty} \ell_1 \ (N_i)$

on each $\ell_1 \ (N_i)$ we put the norm $\| \ \|_i$ given, in theorem 1.2, and put on $\ell_1 \ (N)$ the norm:

$$|||x||| = \sum_{i=1}^{\infty} \|x_i\|_i$$

By theorem 1.2 and the Hahn-Banach theorem choose: $\frac{\phi_i \in \ell_1^{**}(N_i)}{\{0\}}$

so that: $\phi_i = 0 \ on \ Ext \ \overline{(B_{\ell_1^*}(N_i))}^{W^*}$

Notice we many consider $\phi_i$ in $\ell_1^{**}(N)$ by taking:

$\phi_i = 0 \ on \ \ell_1 \ (N_j) \ \forall \ j \neq i$

For each i define $\delta_i : \ \ell_1 \ (I\!N) \to \ell_1 \ (I\!N)$ by:

$\delta_i \; ((\alpha_{ik})_{k \geq 1}) = (\beta_i)$

where: $\beta_i = 0$ if $i \notin N_i$ and $\beta_i = \alpha_i$ when $i = i_k$ in $N_i$

Let: $\psi = \delta_i^{**}(\phi_i)$

It is easily checked that: $\psi_i = 0 \; on \; \overline{Ext\ (B^*_{\ell_1})}^{W^*}$

and on $\ell_1^* \; (N_i)$ whenever $i \neq j$. thus $(\psi_i)_{i \geq 1}$ are linearly independent, since if:

$$\sum_k \alpha_k \, \psi_k = 0$$

with $\alpha_k \neq 0$ for some k, let $u \in \ell_1^* \; (N_k)$ so that:

$\psi_k \; (u) = 1$

then $< \sum_k \alpha_k \, \psi_k \, , \; u \; >= \alpha_k = 0$

a contradiction.

Now set $Y = \overline{Span}\left(\overline{Ext(B_{\ell_1^*(N)})}^{W^*}\right)$

then $Y \perp$ is an infinite dimensional since:

$(\psi_i)_{i \geq i} Y \perp$

But $Y \perp = \left(\frac{E^*}{Y}\right)^*$

hence $\frac{E^*}{Y}$ must be inifinite dimensional.

**Theorem 1.4 [4]**

Le E be a locally convex Haudroff topological space and K be a non-empty compact convex subset of E, then k has an extreme point, and

$K = \overline{Conv}(Ext \; (K))$

**Theorem 1.5**

If X is a closed subspace of a Banach Space $(Y, \; \| \; \|)$, and suppose X has a norm P equivalent to its norm inherited from Y, then there exists an equivalent norm $||| \; |||$ on Y so that:

$|||x||| = P \; (x) \; \forall \; x \; \in \; X$

Proof:

Let $D = \{x \in X : P(x) \leq 1\}$

we may assume that $(B_X, \| \|)D\gamma B_Y$ for some $\gamma > 1$. Set $C = D^\circ \cap B_{Y^*}$ where $D^\circ$ denotes the polar set of D.

Then $\frac{1}{\gamma}B_{Y^*}CB_{Y^*}$, and hence the gauge function $q_C$ of C defines an equivalent norm $||| \; |||$ on $Y^*$ [3]. Thus for any $y \in Y$ we have:

$|||y||| = Swp_C \,|< y^* , y >|$

we show if $x \in X$, then $|||x||| = P(x)$. If $x = 0$, we are done. Suppose $x \neq 0$, set

$u = \frac{x}{P(x)}$

it suffices to show that $|||u||| = 1$.

Note that $u \in D$ since $P(u) = 1$, so if $y^* \subset D^\circ$.

then $|y^*(u)| \leq 1$ or simply $|||u||| \leq t$. Now suppose that $|||u||| = \alpha < \beta < 1$, then for every $y^* \in C$ we have:

$y^*(u) < \beta < 1 \; (**)$

Let M denote the unit ball of $X^*$, when X equipped with the norm P, then.

$P(u) = Sup_M \,|x^*(u)|$

Also, since X is equipped with the norm P, M in $W^*$, compact $mX^*$, then there exists $x_0^*$ in M such that $P(u) = |x_0^*(u)|$, since $x_0^* \in M$, we have $x_0^*(d) \leq 1 \; \forall \, d \in D$. Hence $x_0^*$ belongs to the unit ball of $X^*$ corresponding to the norm inherited from the norm of Y, this of course follows from (**). Thus, there exists $y^* \in Y^*$ such that:

$y^*|_X = x_0^* \; and \; \|y^*\| = \|x_0^*\| \leq 1$

If $d \in D$, then d must be in X, so:

$|y^*(d)| = |x_0^*(d)| \leq 1$, which implies that $y^* \in D^\circ \cap B_{Y^*}$. Hence it follows that $y^*(u) \leq \beta < 1$ but $|y^*(u)| = |x_0^*(u)| = 1$, a contradiction, hence $|||u||| = 1$ or $P(x) = |||x||| \; \forall \, x \in X$.

### Lemma 1.6

If X is a closed subspace of a Banach Space $(Y, \| \|)$ and suppose X has a norm P equivalent to its norm iherited from Y, the there exists a norm on Y such that if $Q: X \to Y$ is the natural embedding, then:

$$Q^* \left( \overline{Ext\ (B_{Y^*})}^{W^*} \right) = \overline{Ext\ (B_{X^*})}^{W^*}$$

Proof:

Let $Q: X \to Y$ denote the natural embedding of X into Y. By theorem 1.5 there exists an equivalent norm $||| \ |||$ or Y such that:

$$|||x||| = P\ (x)\ \forall\ x\ \in\ X$$

Let $Q^*: (Y^*, ||| \ |||) \to (X^*, ||| \ |||)$ be the adjoint mapping, it is then clear that:

$$|||Q^*||| = 1$$

Set $K = \overline{Ext\ (B_{X^*})}^{W^*}$ and let $K' = Q^{*^{-1}}(K) \cap B_{Y^*}$ now if $X \perp$ is the annihilator $X^*$ in $(Y^*, ||| \ |||)$, let L be the unit ball of $X \perp$ with respect to the dual norm $||| \ |||$. The the set $K'' = K' \oplus 2L$ is $W^*$ compact and hence if we set $C = \overline{Conv}^{W^*}(K'')$, we first show that $B_{Y^*}C$:

Let $y^* \in B_{Y^*}$, if $Q^*\ (y^*) \in K$ we are done, since $y^* \in Q^{*-1}(C)$ and hence $y^* \in K'K''C$, if not, then first notice that $Q^*\ (y^*)B_{X^*}$, then by theorem 1.4:

$$B_{X^*} = \overline{Conv\ (Ext\ (B_{X^*})}^{W^*}$$

then we must have: $Q^*\ (y^*) = W^* -_{\alpha}\ (\sum_{i=1}^{J\alpha} \lambda_{i,\ \alpha} x^*_{i,\ \alpha})$

where $x^*_{i,\ \alpha} \in Ext\ (B_{Y^*})$. Now for each $\alpha$ there exists $y^*_i \in B_{Y^*}$ such that. $Q^*\ (y^*_{i,\ \alpha}) = x^*_{i,\ \alpha}$ observe that $x^*_{i,\ \alpha} \in K$ implies that $y^*_{i,\ \alpha} \in K'$ and hence we see that the net:

$u_\alpha = \sum_{i=1}^{J\alpha} \lambda_{i,\ \alpha} y^*_{i,\ \alpha}$ is in $\overline{Conv}^{W^*}(K')$, this set being $W^*$ - compact forces $(u_\alpha)$ to have a subset $(u_\beta)$ such that $u_\beta \to u,\ u \in \overline{Conv}^{W^*}(K')$.

Now observe that:

$$Q^*\ (y^*) = W^* -_\beta\ (\sum_{i=1}^{J_\beta} \lambda_{i,\ \beta} x^*_{i,\ \beta})$$

$$i.e\ Q^*\ (y^*) = W^* -_\beta \sum_{i=1}^{J_\beta} \lambda_{i,\ \beta} Q^*\ (y^*_{i,\ \beta})$$

$$= W^* -_\beta Q^*\ (\sum_{i=1}^{J\beta} \lambda_{i,\ \beta} y^*_{i,\ \beta})$$

$$= W^* -_\beta Q^*\ (u_\beta)$$

$$= Q^*\ (u)$$

which means that $Q^*\ (y^* - u) = 0$ and hence $y^* - u\ \in\ X\ \perp$, but notice that $|||y^* - u|||\ \leq\ 2$, thus $y^* - u\ \in\ 2L$. Consequently

$$y^*\ \in\ \overline{Conv}^{W^*}\ (K') + 2L$$

but: $\overline{Conv}^{W^*}(K')\ \oplus\ 2L\overline{Conv}^{W^*}(K'\ \oplus\ 2L)C$, which implies that $y^*\ \in\ C$ or $B_{Y^*}C$. This and [3] shows that the guage function $q_C$ of defines an equivalent dual norm on $Y^*$. Now we show this is the needed norm to do the Job:

First by [2] not that $Ext\ (C)K''$

and hence $\overline{Ext\ (C)}^{W^*}\ K''$, there for:

$Q^*\ (\overline{Ext\ (C)}^{W^*})Q^*\ (K'')$, but $Q^*\ \equiv\ 0$ on L so

$Q^*\ x\overline{Ext\ (C)}^{W^*})Q^*\ (K') = Q^*\ (Q^{*-1}(K)\ \cap\ B_{Y^*})$

$K$

In particular this shows that:

$$Q^*\ (C)\overline{Conv\ (K)}^{W^*} = B_{X^*}$$

To finish the proof, we show that: $KQ^*\ (\overline{Ext\ (C)}^{W^*})$

Let $u\ \in\ K = \overline{Ext\ (B_{X^*})}^{W^*}$, then there exists a set $(u_\alpha)$ in $Ext\ (B_{X^*})$ such that $u = W^* -_\alpha u_\alpha$. Let $F_\alpha = Q^{*-1}(u_\alpha)\ \cap\ C$, since $B_{Y^*}C$, then

$\phi \neq B_{Y^*} \cap Q^{*-1}(u_\alpha)F_\alpha$ $i.e.$ $F_\alpha \neq \phi,$ $W^*$

closed convex subset of C. In fact $F_\alpha$ is a face of C: $F_\alpha$ being $W^*$ - compact and convex it contains an extreme point, and since $F_\alpha$ is a face, such an extreme of $F_\alpha$ must be an extreme point of C. Hence there exists $y^*_\alpha \in Ext\ (C)$ such that $Q^*\ (y^*_2) = u\ alpha$. Since C is $W^*$ - compact, the set $(y^*_\alpha)$ has a convergent subset. $(y^*_\beta)$ such that $y^*_\beta \to y^*$, but $Q^*$ is $weak^*$ to $weak^*$ continuous implies that:

$u =_\beta\ Q^*\ (y^*_\beta) = Q^*\ (_\beta\ y^*_\beta) = Q^*\ (y^*)$

so $u \in Q^*\ (\overline{Ext\ (C)}^{W^*})$ or simply:

$KQ^*\ x\overline{Ext\ (C)}^{W^*}$), and hence we have shown that:

$\overline{Ext\ (B_{X^*})}^{W^*} = Q^*\ (\overline{Ext\ (C)}^{W^*})$

where C is the unit ball of $Y^*$ when equipped with the dual norm $q_C$.

**Theorem 1.7**

If Y is a Banach Space containing an isomorphic copy of $\ell_1$, the there exists a norm on Y such that

$\frac{Y^*}{\overline{Span\{\overline{Ext\ (B_{Y^*})}^{W^*}\}}}$ is infinite dimensional

Proof:

Let $T:\ \ell_1 \to Y$ be on isomorphic embedding of $\ell_1$ into Y. Now put on $\ell_1$ the norm $|||\ |||$ defined in Lemma 1.3, set $X = T\ (\ell_1)$, and for each $x = T,\ z)$ in X let $P\ (x) = |||z|||$, note that T is map from $\ell_1$ on to X. It is clear that P define a norm of the closed subspace X of Y that is equivalent to norm inherited from Y. Hence by Lemma 1.6 there exists a norm on Y such that if $Q:\ X \to Y$ denotes the natural embedding then:

$Q^*\ (\overline{Ext\ (B_{Y^*})}^{W^*}) = \overline{Ext\ (B_{X^*})}^{W^*}$

Now by lemma 1.3 we know there exists a sequence $(\ \psi\ _i)_{i\ \geq 1}$ of linearly independent elements in $(\ell_1,\ |||\ |||)^*$ such that for each $i\ \geq\ 1\ \psi\ ^*_i\ \equiv\ 0$ on $\overline{Ext\ (B_{\ell^*_1})}^{W^*}$

For each $i \geq 1$ let $g_i = Q^{**}(T^{**}(\psi_i))$, hence $g_i \equiv 0$ on $\overline{Span(Ext\ (B_{Y^*})}^{W^*})$. Furthermore the elements of the sequence $(g_i)_{i\geq 1}$ are linearly independent since the elements of $(\psi_i)_{i\geq 1}$ are and $Q^{**}T^{**}$ is one-to-one. Let

$$z = Span\ (\overline{Ext\ (B_{Y^*})}^{W^*})$$

then for each $i \geq 1$ $g_i$ is in the annihilator $z^1$ of z in $Y^{**}$. Hince $z\perp$ is an infinite dimensional subspace of $Y^{**}$, since $\left(\frac{Y^*}{z}\right)^* \approx z\perp$. This shows that $\frac{Y^*}{z}$ must be infinite dimensional.

**Theorem 1.8**

If Y is a Banach Space containing an isomorphic copy of $\ell_1$, then there exists a norm on Y and an infinite dimensional subspace z of $Y^{**}$ such that: if $\frac{g\in z}{\{0\}}$, and $f \in Y$ satisfies $\|f\| < \frac{1}{2}\|g\|$ then:

$f + g$ does not expose $B_{Y^*}$

Proof:

By theorem 1.7 $W = \frac{Y^*}{\overline{Span(Ext\ (B_{Y^*})}^{W^*})}$ is infinite dimensional. So if we let:

$$z = W^* \approx [Span\ x\overline{Ext\ (B_{Y^*})}^{W^*})]\perp$$

than if $g \in \frac{z}{\{0\}}$ and if $f \in Y$, with $\|f\| < \frac{1}{2}\|g\|$ but $f+g$ exposes $B_{Y^*}$, then there exists $x_0^* \in Y^*$ at which $f+g$ exposes $B_{Y^*}$, but $x_0^*$ must be an extreme point of $B_{Y^*}$.

Hence $g\ (x_0^*) = 0$. Now:

$$\|f+g\| = |(f+g)\ (x_0^*)|$$
$$= |f\ (x_0^*)|$$
$$= \|f\|$$

on the other hand we have:

$$\|g\| \leq \|f+g\| + \|f\|$$
$$\leq 2\|f\|$$

or $\|f\| \geq \frac{1}{2}\|g\|$ a contradiction, so $f+g$ does not expose $B_{Y^*}$.

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# SOME MINERALS AND CONSTITUENTS CONTENT OF LOCAL Hibiscus sabdariffa SEEDS.

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## ABSTRACT

The contituents of local roselle seed (which is 20% of lgowe by weight) moisture, total ash, protein, reducing, sufars and oils were determined and found 42.50, 9.14, 21.70, 4.26, and 15.60% respectively.

The fatty acids of seed oil were identified by gas chromatography. The percentages of major fatty acids linoleic, oleic, palmitic were determined and found 44.73, 31.73 and 20.40% respectivety. The G.c. gave small amount of stearic acid (2.47%).

The minerals K, Na, Ca, P, Mg, Fe, S, Mn, Zn, and Cu were determined and found 246.92, 66.06, 53.89, 46. 53, 3.30, 6.24, 4.43, 0.45, 1.25 and 0.27 Mg/gr. respectively. The minerals Ni, Cd, Cr, and Pb were found as trace elements gave amounts less than O.L Mg/gr.