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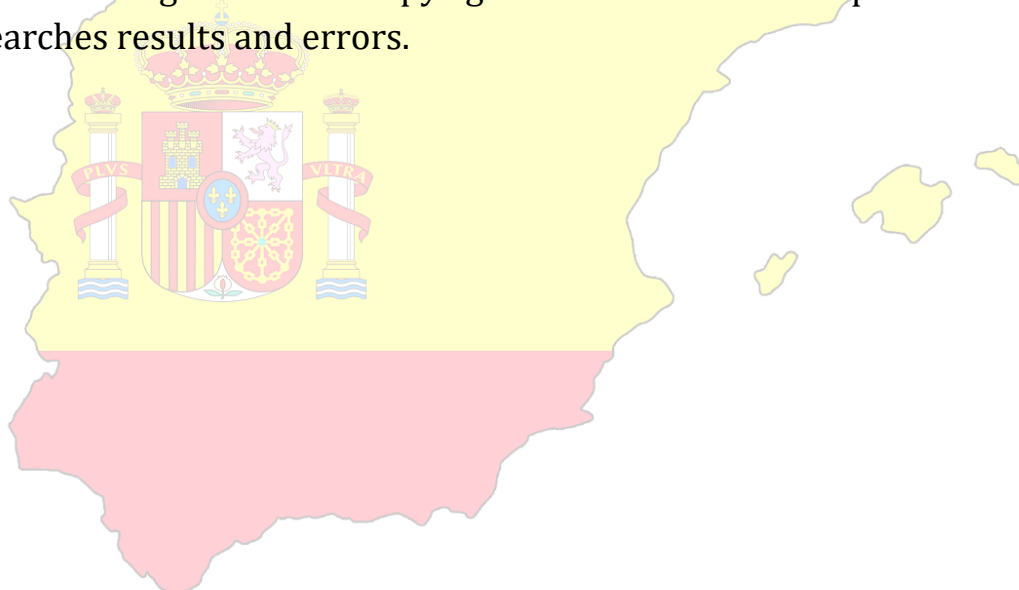


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Meva sharbatlaridagi temir ionlarini sifat va miqdor jihatdan tahlil qilish

Berdiyeva Zulfiya Muxiddinovna

Buxoro davlat texnika universiteti "Kimyo texnologiyasi" kafedrası katta
o'qituvchisi

Zayniyeva Aziza Boypo'lat qizi

Buxoro davlat texnika universiteti "Texnologiya" fakulteti 100-24KM guruh
talabasi

Ro'ziboyeva Zamira Aminboy qizi

Buxoro davlat texnika universiteti "Texnologiya" fakulteti 108-24BT guruh
talabasi

Annotatsiya. Temir inson organizmi uchun eng muhim mikroelementlardan biridir. Kunning tavsiya etilgan temir miqdori kattalar uchun 8-18 mg, bolalar uchun 7-11 mg, homilador ayollar uchun 27 mg ni tashkil qiladi. Temir yetishmovchiligi dunyoda eng keng tarqalgan ozuqa moddalari yetishmovchiligidir. Meva sharbatlari temirning muhim manbai bo'lib, ayniqsa, olma, anor va uzum sharbatlarida temir miqdori yuqori bo'ladi. Maqolada meva sharbatlaridagi temir ionlarini aniqlashning zamonaviy va an'anaviy usullari, ularning afzalliklari va kamchiliklari tahlil qilinadi.

Kalit so'zlar: Temir, meva sharbati, ferroion, ferriion, spektrofotometriya, ferroin, fenantrolin, atom-absorbtsiya, ICP-MS, biologik mavjudlik.

Annotation. Iron is one of the most important trace elements for the human body. The recommended daily intake of iron for adults is 8-18 mg, for children 7-11 mg, and for pregnant women 27 mg. Iron deficiency is the most widespread nutritional deficiency in the world. Fruit juices are an important source of iron, especially pomegranate, apple, and grape juices. The article analyzes modern and traditional methods for determining iron ions in fruit juices, their advantages and disadvantages.

Key words: Iron, fruit juice, ferrous ion, ferric ion, spectrophotometry, ferroin, phenanthroline, atomic absorption, ICP-MS, bioavailability.

Kirish

Temir - Mendeleyev davriy sistemasining VIII guruhiga mansub kimyoviy element (Fe, atom raqami 26). U yer qobig'ida massasi bo'yicha 4,65% ni tashkil etib, eng ko'p tarqalgan to'rtinchi element hisoblanadi. Temir asosan magnetit (Fe_3O_4), gematit (Fe_2O_3), limonit ($FeO(OH) \cdot nH_2O$) kabi minerallar shaklida uchraydi. Inson organizmida temir gemoglobin, mioglobin va turli fermentlar (sito-xromlar, katalaza, peroksidaza) tarkibida topiladi. Temir kislorodni tashish, energiya almashinuvi va DNK sintezida muhim rol o'ynaydi. Meva sharbatlari temirning yaxshi manbai bo'lib, organizm tomonidan oson so'riladigan shaklda bo'ladi.

Temirning biologik ahamiyati va meva sharbatlaridagi o'rni

Temir inson organizmida quyidagi asosiy funktsiyalarni bajaradi:

Kislorodni tashish va tashish (gemoglobin tarkibida), muskullarda kislorodni saqlash (mioglobin tarkibida), hujayra nafasi va energiya ishlab chiqarish, DNK sintezi va hujayra bo'linishi, immunitet tizimini mustahkamlash



Meva sharbatlaridagi temirning ahamiyati quyidagi omillarda namoyon bo'ladi:

1. Tabiiy shaklda mavjudligi - organik birikmalar shaklida
2. Biologik mavjudlik - C vitamini va organik kislotalar tufayli yuqori
3. Oson so'rilishi - o'simlik manbali temir hayvon manbalidagiga nisbatan yaxshiroq so'riladi

Meva sharbatlaridagi temir (Fe^{2+} va Fe^{3+}) miqdorlari va ta'sir omillari

Turli meva sharbatlaridagi temir miqdori quyidagi omillarga bog'liq: Meva turi va navi, yetishtirilgan tuproqning temir tarkibi, iqlim sharoitlari, qayta ishlash texnologiyasi, saqlash shartlari.

Quyida turli meva sharbatlaridagi o'rtacha temir miqdori keltirilgan:

Sharbat turi	Temir miqdori(mg/100ml)	Asosiy shakli
Anor sharbati	0,3-0,8 mg	Fe^{3+}
Olma sharbati	0,1-0,4 mg	Fe^{2+}
Uzum sharbati	0,2-0,6 mg	Fe^{2+}/Fe^{3+}
Apelsin sharbati	0,05-0,15 mg	Fe^{3+}
Limon sharbati	0,03-0,10 mg	Fe^{3+}
Greytfrut sharbati	0,08-0,20 mg	Fe^{3+}

Temirning biologik mavjudligiga ta'sir etuvchi omillar quyidagilardan iborat: C vitamini - Fe^{3+} ni Fe^{2+} ga qaytaradi va so'rilishini oshiradi, organik kislotalar(limon kislota, olma kislota), Fitatlar va taninlar(so'rilishini kamaytiradi), pH darajasi(kislotali muhit so'rilishni oshiradi), Temir ionlarini (Fe^{2+} va Fe^{3+}) sifat tahlili.

Sifat tahlili uchun namuna oldindan tayyorlanadi:

1. Namuna tayyorlash: Sharbatni bir xil holatga keltirish, 0,45 mikronli filtr orqali filtrlash va pH ni 2-3 darajasiga sozlash
2. Organik moddalarni parchalash: Isitish bilan namuna bug'lash, HNO_3 va $HClO_4$ aralashmasi bilan kislotali parchalash va mikroto'lqinli parchalash
3. Temir shakllarini ajratish: Ion almashinish xromatografiyasi, ekstraksiya usullari va membrana filtrlash



Asosiy sifat reaksiyalari:

Reaktiv	Sharoat	Kuzatiladigan natija
Kalium ferrotsianid	Kislotali muhit	Ko'k cho'kma - Prussian Blue
Fenantrolin	pH 3-5	Qizil rang - ferroin kompleksi
Kalium tiotsianat	Kislotali muhit	Qizil rang - $Fe(SCN)_3$
Dimethylglioksim	Ammiakli muhit	Qizil cho'kma
Bathofenantrolin	pH 4-6	Qizil kompleks

Temir ionlarini miqdor tahlili

A. Spektrofotometrik usullar

1). Fenantrolin usuli - eng keng tarqalgan usul

Prinsip: Fe^{2+} ionlari 1,10-fenantrolin bilan qizil rangli $[Fe(phen)_3]^{2+}$ kompleksi hosil qiladi.

Tahlil bosqichlari:

1. Namuna tayyorlash (organik moddalarni yo'q qilish)
2. Hidroksilamin gidroxlorid qo'shiladi (Fe^{3+} ni Fe^{2+} ga qaytarish)
3. Asetat buferi (pH 3-5) qo'shiladi
4. 0,1% fenantrolin eritmasi qo'shiladi
5. 30 daqiqa kutish (rang to'liq rivojlanishi uchun)
6. 510 nm to'lqin uzunligida optik zichlik o'lchanadi
7. Natija kalibrlash grafigi bilan solishtiriladi

2) Ferrozin usuli - yuqori sezgirlik

Prinsip: Fe^{2+} bilan sariq-yashil fluoresasent kompleks

B. Atom-absorbtsion spektrometriya (AAS)

Prinsip: Temir atomlari 248,3 nm to'lqin uzunligidagi nurni yutadi.

Tahlil bosqichlari:

1. Namuna suyultiriladi (1:10 yoki 1:20)
2. HNO_3 bilan mineralizatsiya qilinadi
3. 0,1% $LaCl_3$ qo'shiladi (fosfatlar ta'sirini yo'q qilish)
4. 248,3 nm da absorbtsiya o'lchanadi
5. Gull qizig'i yordamida aniqlik oshiriladi

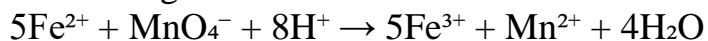
C. ICP-OES va ICP-MS usullari



Induktiv bog'langan plazma spektrometriyasi- eng zamonaviy usul
 ICP-OES parametrlari: To'lqin uzunligi-238,204 nm yoki 259,940 nm, aniqlik chegarasi- 0,001 mg/l, chiziqli diapason- 0,01-100 mg/l.
 ICP-MS parametrlari: Massa-56 Fe, aniqlik chegarasi- 0,0001 mg/l, ko'p elementli tahlil imkoniyati.

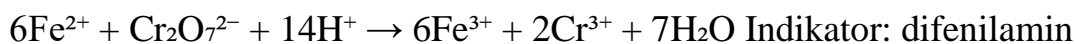
D. Titrlash usullari

1. Permanganatometrik titrlash:



Indikator: o'z-o'zidan rang o'zgarishi

2. Dichromatometrik titrlash:



Tahlil natijalari va tahlil

Turli meva sharbatlarida o'lchangan temir miqdorlari:

Sharbat turi	Jami temir (mg / 100 ml)	Fe ²⁺ (mg / 100 ml)	Fe ³⁺ (mg / 100 ml)	Sorilish (%)
Anoras ha	0,45 ± 0	0,15 ± 0	0,30 ± 0	88 ± 3



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O l m a	0 , 2 5	0 , 1 8	0 , 0 7	7 8
s h a r b a t i	± 0 , 0 5	± 0 , 0 4	± 0 , 0 2	± 4
U z u m	0 , 3 5	0 , 1 2	0 , 2 3	8 2
s h a r b a t i	± 0 , 0 6	± 0 , 0 3	± 0 , 0 4	± 3
A p e l s i n	0 , 1 0	0 , 0 4	0 , 0 6	9 2
s h a r	± 0 , 0 2	± 0 , 0 1	± 0 , 0 1	± 2

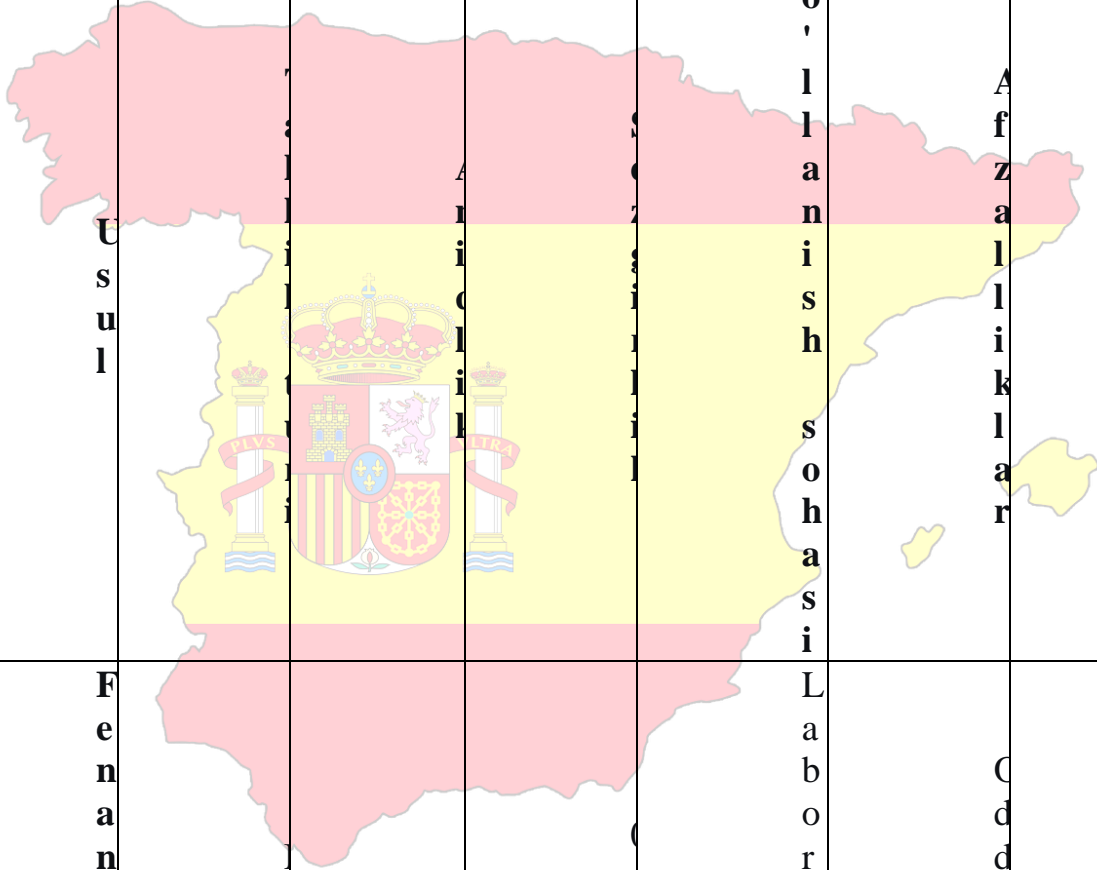
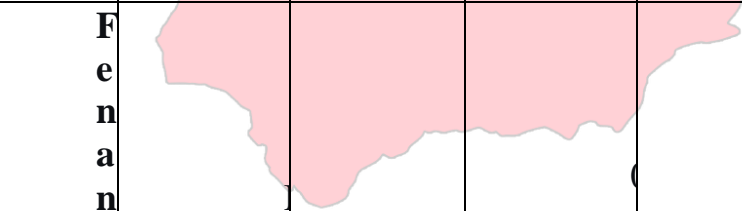


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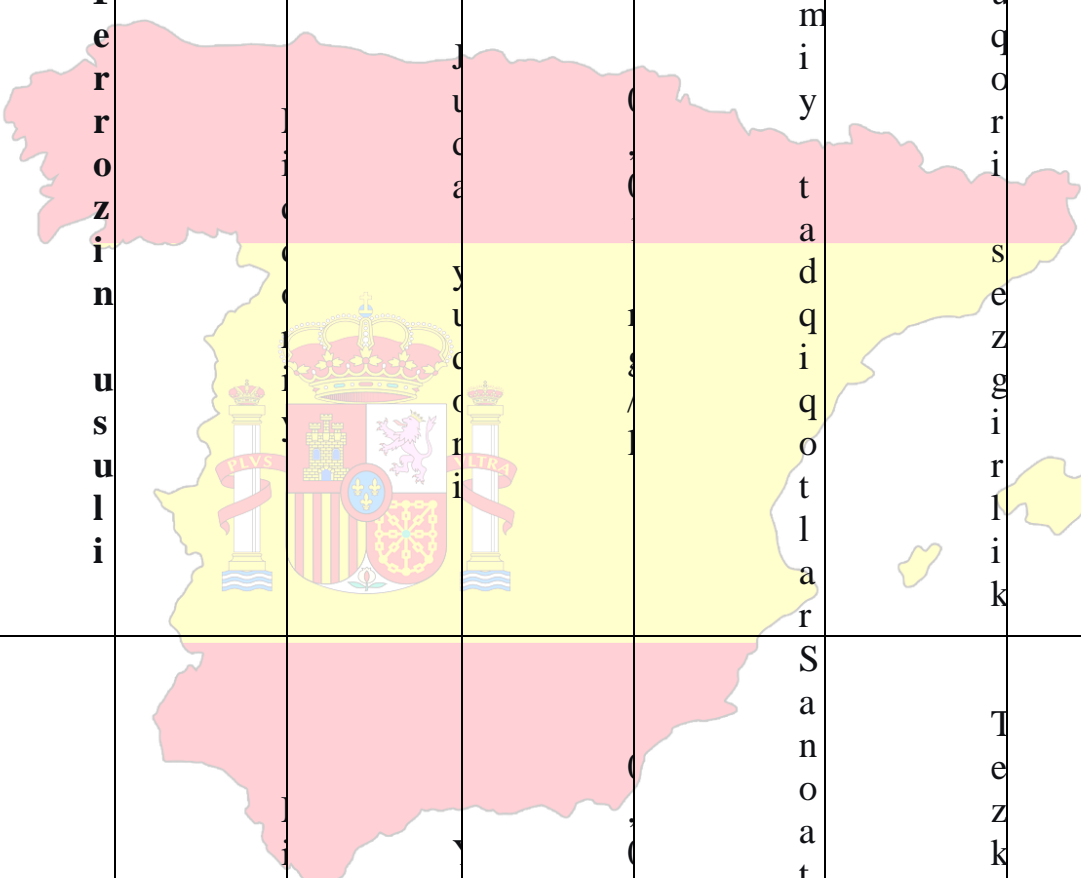
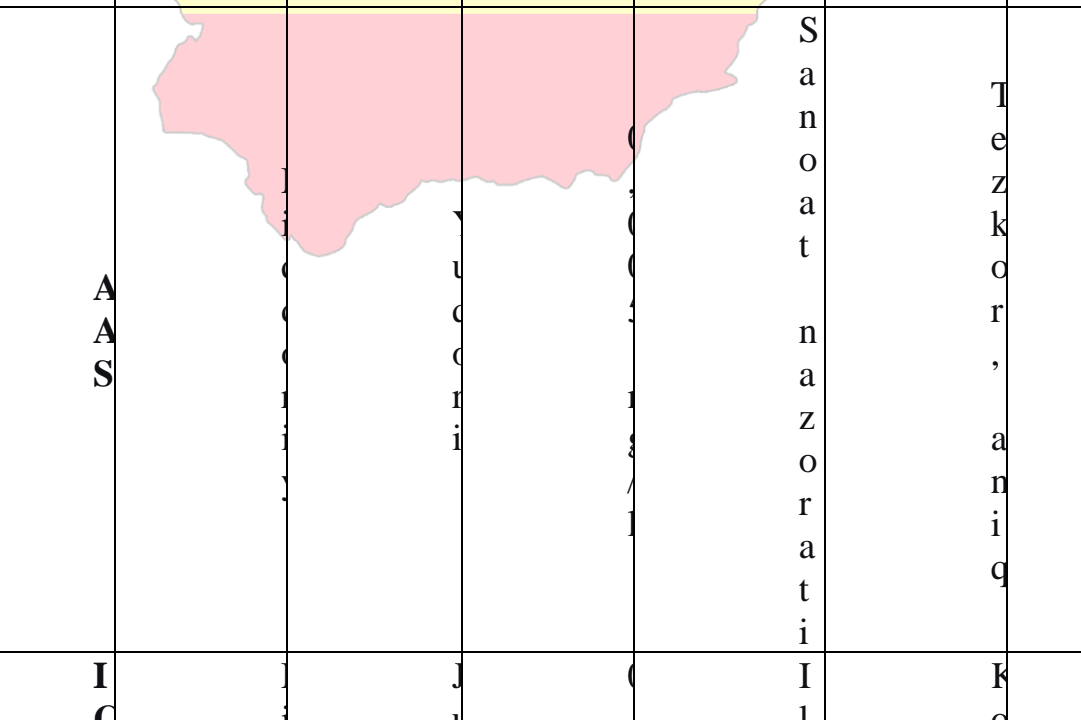
Xatolik manbalari va aniqlikni oshirish usullari:

1. Namuna tayyorlashdagi xatolar - to'g'ri filtrlash va saqlash
2. Kimyoviy aralashmalar - ionlarning o'zaro ta'siri
3. Asbob xatolari - muntazam kalibrlash
4. Operator xatolari - standart protokollarga qat'iy rioya qilish

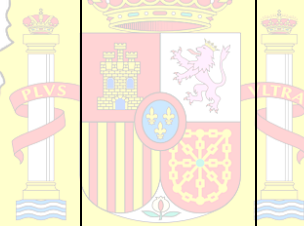
Umumlashtiruvchi jadval

U s u l					Q o ' l l a n i s h s o h a s i	A f z a l l i k l a r	K a m c h i l i k l a r
F e n a n t r o l i n u s u l					L a b o r a t o r i y a t a d	C o d i y , a r z o n	F a q a t F e ² + n i a n



i				q i q o t l a r i		i q l a y d i
F e r r o z i n u s u l i				I l m i y t a d q i q o t l a r	Y u q o r i s e n g i r l i k	M a x s u s r e a g e n t l a r
A A S				S a n o a t n a z o r a t i	T e z k o r , a n i q	Q i m m a t j i h o z
I C		J u		I l	K o	J u



<p>P - O E S</p>				<p>m i y t a d q i q o t l a r</p>	<p>' p e l e n e n t l i t a h l i l</p>	<p>d a q i m m a t</p>
<p>I C P - M S</p>				<p>T o k s i k o l o g i k t a h l i</p>	<p>I z n i q d o r d a g i a n i q l a s h</p>	<p>J u d a m u r a k k a b v a q i m m a t</p>



T i r l a s h u s u l l a r i				D a s t l a b k i t a h l i	O d d i y , a r z o n	P a s t s e z g i r l i k
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Xulosa va tavsiyalar

1. Meva sharbatlari temirning muhim manbai bo'lib, ularni muntazam iste'mol qilish orqali inson organizmining kunlik temir ehtiyoji qisman qoplanadi.
2. Temir miqdorini aniqlashning turli usullari mavjud bo'lib, ulardan laboratoriya imkoniyatlariga qarab foydalanish mumkin. Oddiy laboratoriyalar uchun fenantrolin usuli, ilmiy tadqiqotlar uchun esa AAS va ICP usullari tavsiya etiladi.
3. Temirning biologik mavjudligini oshirish uchun: C vitamini bilan birga iste'mol qilish, kislotali muhitda saqlash va oksidlanishning oldini olish
4. Kelajakdagi tadqiqotlar yo'nalishlari: Nanozarrachalar yordamida aniqlash usullari, tezkor test-tizimlarini ishlab chiqish, biologik mavjudlikni oshirish texnologiyalari.



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