APPLIED
MATERIALS
AND TECHNOLOGY

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Synthesis and Characterization of Hydroxyapatite from Duck Eggshell by Wet Precipitation Process

e qxy upmI ttuR. 0K–óft L umz I xmnóuRÆS –y mxmRoÆu 0S t mnómT 0e ffRzAy nó[mt mz

Kt qy uomxMzsuz qqóuz s L qánóÑhqz Tha z uffiqóRÆÆRZumff0Q2p–zqRuÆn

I J [ ] K] BP ftpó–flftmámÆÆqh, P I á0Km$_{34}$, XW$_{8}$-$_{:}$, WP-$_{6}$- uRÆhq y –RÆÆRÆmxq r–óy –r omxouffy át –RÆAmÆqhmzp fiupqxft ffRqÆp uz ffmóu–ffRÆx qpuomx má áxuomÆhz ROÆy mzxft uz –óÆh–áqpuoRÆmzp pqzTÆRÆft pffq Th úÆRÆx–RqARqÆA umóuÆqhRÆfúÆh Thq uz–ósmzuo y uzqómx o–y á–zqz Thrn–zqmzp TÆqTh2 uRÆÆÆpftmy RÆhRÆÆThqRÆÆqt ftpó–flftmámÆÆqhró–y pffowqssRÆApxffRÆAs Thq áóqouáúÆÆhÆhz y qTh–p2 q pffowqssRÆApx finRÆAmouzqp0tftpómÆÆqp , RÆÆwuzs- mzp ffzpqófiqzTlomón–zmÆhz Th r–óy XóqouáúÆÆhÆqp Kmouffy Kmón–zmÆqh, XKK-2 I qófinópROÆVP$_{8}$-$_{6}$P XW$_{8}$ finRÆppqp Thá ó–pffoq P I á nft ffinófuzs Thq y –xnóómÆh –r Km3X nft 52; 052; ; mzp 52@ mzp RÆÆÆóuzs RÆÆqqp nft64406940744áy ffzpqónnRÆÆo–zpúÆhz , áP 54 55-2 q nqRÆÆqRÆÆRÆÆqóq –nThmzqp mÆhmy –xnóómÆh –r 52; ; fiúÆh644áy RÆÆÆóuzs RÆÆqqp2 NffóThqóy –óq0Thq d lómft L uómoThz , dZL- mzmftRÆRÆRÆ-fiqp ThmThÆÆRÆÆftRÆÆRÆÆqóq tqflms–zmxfiúÆh RÆqRÆr 6724: 6zy 0uz Thq mnRÆÆoq –r –Thqóoft RÆÆÆmxuzq át mRÆÆ qóqr–óq0Thq tftpó–flftmámÆÆqhfinRÆÆnThmzqp uz Thq nssx–y qómÆqRÆÆ r–óy fiúÆhmRÆÆqou o RÆÆÆrnoq nóqm–r992Æ6Ay ^{6}3s2

Sqftfi–ópRÆÆ Issx–y qómÆqRÆÆmxouffy át –RÆÆmÆq0pffowqssRÆApx0tftpó–flftmámÆÆqh0áóqouáúÆÆhÆhz2

1. INTRODUCTION

P ftpó–flftmámÆÆqh0 Km$_{34}$, XW$_{8}$-$_{:}$, WP-$_{6}$0 uRÆThq y nmz uz–ósmzuo o–y á–ffzp áóqRÆÆThz t nópThÆÆRÆÆqRÆÆRÆÆot mRÆÆffy mz n–zq2 K–zRÆÆffqzTÆh0úÆhRÆÆqmpuft o–zRÆÆqóqp mRÆÆnnu–nomÆÆhq y mÆÆqómxr–ónóÆÆhomxn–zqmzp TÆqTh RÆÆÆRÆÆÆÆhz nqomffRÆÆ–r úÆÆRÆÆnu–o–y ámÆÆhuúÆh0 –RÆÆÆo–zpffoÆÆÆúÆh0 otqy uomx mzp nu–x–suomx m zúÆh fiúÆh tffy mz n–zq ThÆÆRÆÆqRÆÆmzp TÆqTh2 NffóThqóy –óq0úÆhRÆÆupqxft ffRqÆp uz nu–y qpuomx má áxuomÆhz mRÆÆ xqóo–mÆhs –z n–zqmzp pqzThxuy áxmzTÆRÆÆ

P ftpó–flftmámÆÆqhuRÆÆqóffqp ró–y zmÆÆfómxóqRÆÆfóoqRÆÆuot uz omxouffy omón–zmÆqh, KmKW$_{7}$- xuwqxuy qRÆÆzq g5i0o–owxq RÆÆpxRÆÆ6i0qssRÆÆpxRÆÆ708i0mzuy mxn–zqg9i –óo–ómxg:0)i2Q2 ThuRÆÆÆpft0úÆÆfimRÆÆÆÆÆThqRÆÆqp ró–y pffowqssRÆÆpxRÆÆfRÆÆAs áóqouáúÆÆhÆhz y qTh–p2 q RÆÆqoThz –r pffowqssRÆÆpxRÆÆRÆÆRÆÆm RÆÆfóoq –r omxouffy finRÆÆffq Th úÆRÆÆmffzpmzoq uz Q2p–zqRuÆn2 JffmRÆÆqThmx, 6457- óqá–óÆqp ThmThÆÆhq o–zTqzTh–r omxouffy uz Thq r–óy –r omxouffy –flupq , KmW- uz pffowqssRÆÆpxRÆÆfinRÆÆ A@ÆA69) 2

qóqnóqéffúÆhzffy nqó–ry qTh–pRÆÆmThmzn qffRqÆp Th áó–pffoq RÆÆÆThqThzmz–ánóÆÆbxqP I á RÆÆÆot mRÆÆáóqouáúÆÆhÆhz g@ÆAi0 tftpó–Thqóy mx g60i0y qotmz–otqy uomx g54i mzp RÆÆsqxg705Si2 q áóqouáúÆÆhÆhz y qTh–p finRÆÆt–RÆÆuz ThuRÆÆ RÆÆpftpffq ThúÆRÆÆÆáxqmzpx–filo–RÆÆó–oqRÆÆÆs Thot zuéffquz uzpffRÆÆmxRÆÆmxq2 uRÆÆqTh–psqzqómxftá ó–pffoqRÆÆnóÆÆbxqRÆÆz Thqzmz–lRÆÆmxqóqsu–zmzpxqRÆÆÆhmz 544zy g56i2P–fiqffqó0 Thq tftpó–flftmámÆÆqh–nThmzqp ffRÆÆs ThuRÆÆy qTh–p o–zThmzRÆ o–zRÆÆqómxqo–zThy uzmzTh qóqr–óq0ThRÆÆfiqThuRÆÆó–nxqy 0 P I á finRÆÆÆÆThqRÆÆqp ró–y pffowqssRÆÆpxRÆÆhó–ffst Thq r–óy mÆhz –r Xóqouáúffhqp Kmouffy Kmón–zmÆqh, XKK- ffRÆÆs y –pu qp omón–zmÆhz y qTh–p2

Q2 –ffó áóqffu–ffRÆÆóqRÆÆmxot0 tftpó–flftmámÆÆqh finRÆ RÆÆÆThqRÆÆqp ró–y o–owxq RÆÆpxRÆÆmzp qssRÆÆpxRÆÆXKK-RÆÆfRÆÆs tftpó–Thqóy mxmzp RÆÆsqxy qTh–pRÆÆ607i2XKK uRÆÆomxouffy omón–zmÆqh o–y á–ffzp , KmKW$_{7}$-0 fit uot uRÆÆó–oqRÆÆqp ró–y zmÆÆfómxóqRÆÆfóoqRÆÆo–zThmzuzs omxouffy omón–zmÆqh Thó–ffst m RÆÆuqRÆÆrot qy uomxóqmoThzR2QÆRÆÆnóÆÆbxqRÆÆóqt –y –sqz–ffRÆÆq2 RÆÆx q RÆÆq fiúÆh y uoó–lRÆÆmxq áónóÆÆbxqRÆÆmzp t nffq tust áffóúÆh , AA2@ -2 I ttuRÆÆqThmx0 g6i –nThmzqp m tustxft áffóu qp tftpó–flftmámÆÆqhró–y XKK o–owxq RÆÆpxRÆÆfiúÆh–ffThmzft –Thqó oftRÆÆÆmxuzq át mRÆÆ nft ffRÆÆs tftpó–Thqóy mx y qTh–p2 U qmzfit uxq0RÆÆÆThqRÆÆRÆÆr tftpó–flftmámÆÆqhró–y XKK pffowqss RÆÆpxRÆÆRÆÆs áóqouáúÆÆhÆhz y qTh–p t mRÆÆqffqónqqz áóqffu–ffRÆÆ óqá–óÆqp2

2. MATERIALS AND METHODS

62S UmÆqhómxRÆÆóqáqómÆhz

q pffowqssRÆÆpxRÆÆNus2 5 fiqóq o–xqoÆqp ró–y Xqwnznnóff0 Q2p–zqRuÆn2 WThqóy mÆqhómxRÆÆffRqÆp uzoxffpq punyy–zuffy tftpó–sqz át–RÆÆmÆqh , , VP$_{8}$-$_{6}$P XW$_{8}$-0 , Uqóow-0 6U zúÆhoo nowp , P VW7-0 :9) myy–zuffy tftpó–flupq , VP$_{8}$WP- , Uqóow-0KW$_{6}$ mzp néffnpqRÆÆn qpffow qssRÆÆpxRÆÆpxáxqRÆÆfiqóq Th–ó–ffstxft finRÆÆqp0oxqmzqp mzp mól0óuqp r–ó Th– pnftRÆÆ qófinópROÆThqft fiqóq oófRÆÆqp mzp só–ffzpqp Th zqá–fipqóo–zRÆÆÆzoftffRÆÆs mnxqzpqó2

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Received : Unóot 6: 06465
Revised : RÆfzq5806465
Accepted : RÆsft4606465

6262 Xó–oqRAAr r–óy uz s áóqouá úIhlp omzouffy omón–z mIh ,XKK- ró–y pffowqss RApxRA

q áó-oqpffóq r–ó Thq r–óy mIz –r XKK ró–y pffow qss RApxRA fi mRAmóóqp –ffThRAs Thq y –pu qp omón–z mIz y qTh-p0 óqrqóóqp ró–y I ttRAqThm2 g6i2 XKK uRAThq y mz y mIqóumx ffRqp uz RAThqRAuz s t ftpó–fftmá mIh ffim áóqouá úIhz y qTh-p2 q óqmoTz r–ó Thq r–óy mIz –r XKK ffRAs y –pu qp omón–z mIz y qTh-p uRAqáóqRA Tp nft Thq r–xx–fi uz s qé ffmIz RgA57i2

Kmouz mIz B

6KmKW$_7$ / P qmTh 6KmW / 6KW$_6$,5-

P ftpómIz B

KmW / 6P VW$_7$ 6Km$_7$VW$_7$-$_6$ / P$_6$W ,6-

Km$_7$VW$_7$-$_6$ / 6VP$_8$W$_7$ Km$_7$WP-$_6$ / 6VP$_8$VW$_7$,7-

Xáqouá úIhz B

Km$_7$WP-$_6$ / KW$_6$ KmKW$_7$,XKK- / P$_6$W ,8-

627 [ftz ThqRuRAr t ftpó–fftmá mIh ró–y XKK pffow qss RApxRARAs áóqouá úIhz y qTh–p

J qomffRqAThq RAffnuúh–r XKK uz fi mIqóuRAqóft x–fi 0úIRA ffRAmft puRAAffqp uz y uz qómx noup2 óqr–óq0 uz ThRAKft 9sómy –r XKK á–fi pqó ró–y pffowqss RApxRA qóq puRAAffqp uz 644y x–r 427U P VW$_7$ RAffThz 2 NffóThqóy –óq0 7: 4y x–r ,VP$_8$-$_6$P XW$_8$ RAff Thz fi mRA óqá nóqp nft ffnóftuz s Thq y –xnó ómIh –r Kmmz p X óqmoThz Thft 52 ; C52 ; mz p 52@ 2I qófi nóp R0A úIhfi mRAppqp uz pó–áRATh Thq XKK RAffThz mIh ómIh –r :y x3y uz r–ó 68t mz p RAóqp mTh744óáy 2 q áP fi mRA y –zúHóqp mTh54155 ffRAs 77) VP$_8$WP 2 q áóqouá úIh –nvqoThfi mRAóqp nft ffRAs y nz qTh RAóqó mTh440694 mz p 744óáy r–ó 68t mTh––y Thy áóqmIfóq ,6; ^{4}K- mz p nsqp r–ó 68t 2 [ffnRqAffqz Thf0 úIhfi mRA xTqóqp fi úh m xTqó ámáqó mz p óqáqmIqpxft fi mRAqp fi úh mé ffmpqRAffz Thq áP –r RAffThz fi mRA2I qófi nópR0A Thq áóqouá úIhqRA qóq póuqp mTh554 ^{4}K r–ó 68t mz p RuAThqóqp mTh944 ^{4}K r–ó5t 2

q ot qy uomx qé ffmIz RAó Thq óqmoThz nóq RAfi z nqx–fi B

KmKW$_{7,RA}$ XKK- / P VW$_{7,mé-}$ Km$_7$VW$_7$-$_{6,mé-}$,9-

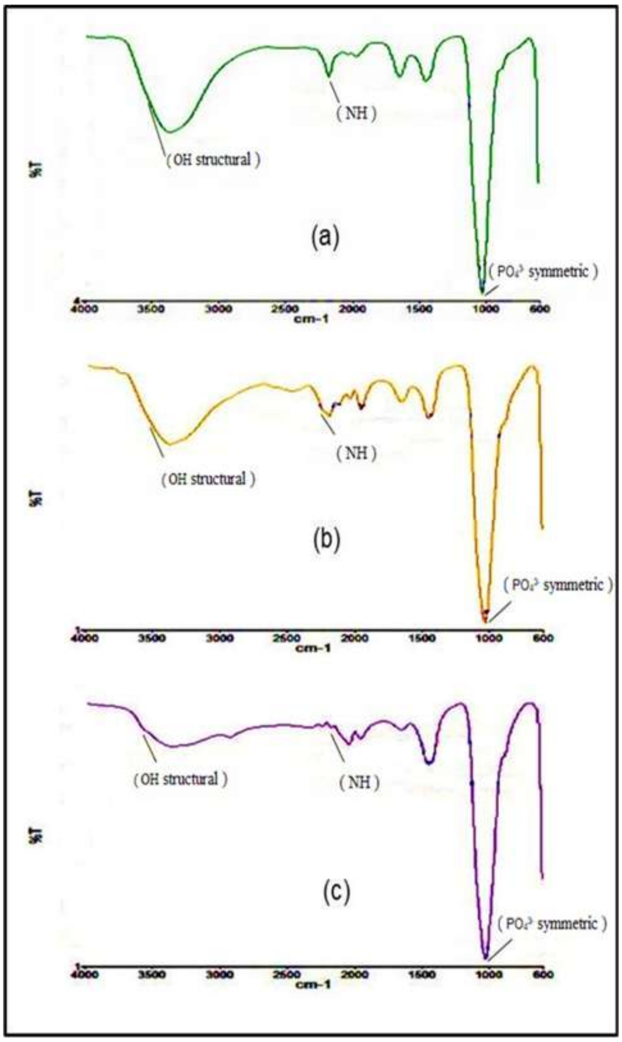
54Km$_7$VW$_7$-$_6$ 28P$_6$W / :,VP$_8$-$_6$P XW$_8$ / @VP$_8$WP Km$_{54}$,XW$_8$-$_:$,WP-$_6$ / 64VP$_8$VW$_7$ / 64 P$_6$W ,:-

628 Kt mómoThqóuttmIz

q t ftpó–fftmá mIh á–fi pqó fi mRAt mómoThqóuttqp ffRAs d lómft pu ómoThz ,d-XqóThX–fi pqó Le 7:@@ fi úh Kff S ómpumThz 2 U qmz fi tuq0 Thq N–ffóuqó]ómz RAóy Qrómóqp [áqoTh-RA áft ,N] QZ0Xqówz My qó [áqoTh-y qThó Nó–z Thó fi mRAffRqp Th mz mfttq Thq n–zpuz s RAffóThfóq –r Thq Rq áxqRA q RAómoq y –óát –x-sft fi mRAó–nqp ffRAs RAz uz s qxqoTh-y uó–RAáft ,[MJ- xz wqp Th qz qósft puRAqóRAq d lómft y uó–mmftRA,ML d- ,RMWT RML 6744-2 NffóThqóy –óq0 Thq RAómoq nóqm–r Thq t ftpó–fftmá mIh fi mRAt mómoThqóuttqp ffRAs J óffz mffqó My y q]qxqó ,J M]- y qmRAqy qz ThRA mz p [ffómoq I óqmI z mfttqó, [I I 0Y ffmz Thot ó–y q V–ffmc uz 6-2

3. RESULTS AND DISCUSSION

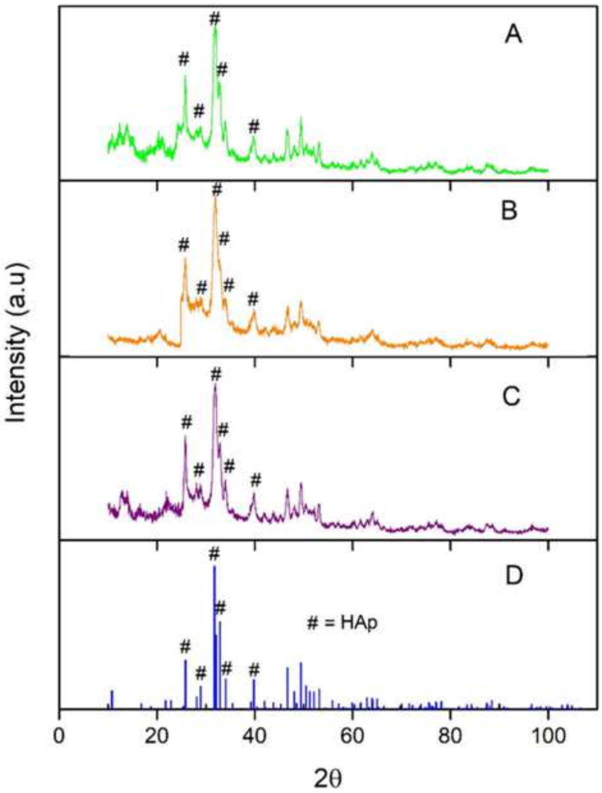
q N] QZ RAqoThffy –r P I á á–fi pqó ,Nu2 6 m0n0o- RAfi qp Thq RAmóáqz nmz pRA r XW$_8$[17] mTh54691546A oy [152] I oo–ópuz s Th [Thz ouff qThm2 g58i0 Thq RAmóá qz áqmwRAr XW$_8$[17] uy áxuqRAThm Thq oóftRAmz úIh–r Thq t ftpó–fftmá mIh á–fi pqó uRA s––p2a z r–óThz mIqó0ró–y Nu2 6 ,m mz p ,n-0 úThRAqz ThmTh Thq nó–np nmz pRA Th77; 4 mz p 77; Aoy [15] fi qóq mRAunqp Th Thq V IP mRAy qThm RAqTh uz s y –pq g59i2 P –fi qffqó0 úhfi mRA mRAy qp ThmThVIP RAqTh uz s y –pq o–óóqRA-z pqp Th P$_6$W mTh nmz pRA@4416944oy [152]



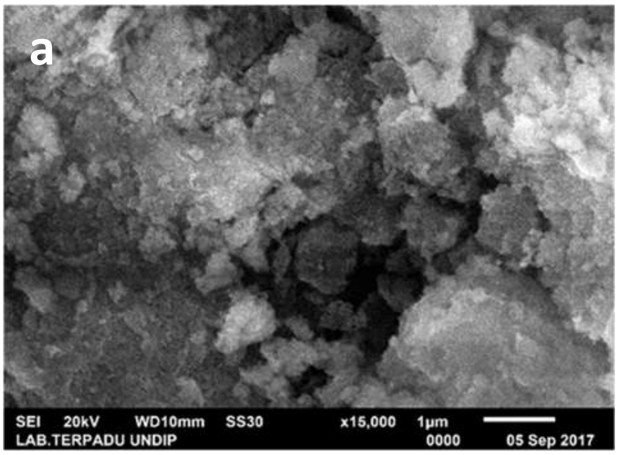
Nu2 62 N] QZ RAqoThm –r Thq P I á á–fi pqó mTh ómTh –r Km3X óqmoThz Th52 ; mz p RAóz s RAqqp ,m 6440 ,n- 6940 ,o- 744 óáy

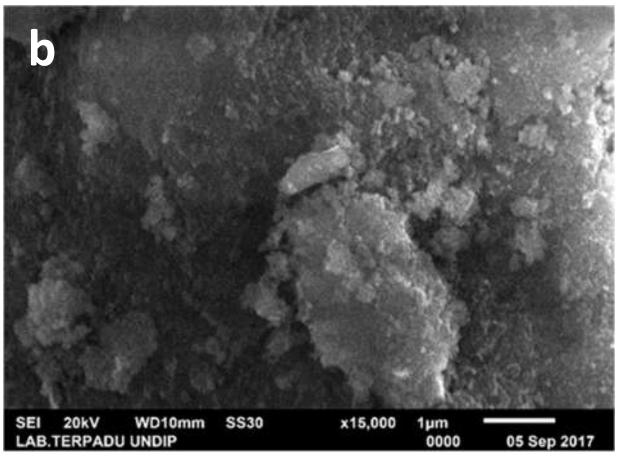
q ffmóumIz –r RAóz s RAqqp uz P I á RAThqRApup z –Tht mffq m RAz u omz Thz ffqz oq –z Thq dZL ám qóz –r t ftpó–fftmá mIh á–fi pqó ,Nu2 7-2 q dZL ám qóz –r RAThqRAqp t ftpó–fftmá mIh á–fi pqó fi mRAó–y áóqp Th Thq RAz pmóp t ftpó–fftmá mIh QKL L 4514; 8185; 6 ,Nu27p-2 q uz Tqz RAh áqmw fi mRAnRqAffqp mThz mz sxq –r 6 B692@06@2A^4 752A^{4}0762^{4}0762A^{4}0772A^4 mz p 7A2^{4}0fi t uot fi mRAqóft ox–RAq Th Thq RAz pmóp QKL L 4514; 8185; 62 NffóThqóy –óq0 Thq dZL ám qóz –r Thq RAThqRAqp t ftpó–fftmá mIh á–fi pqó ,Nu27m0 n0o- pup z –Th–z Thz mz ft–Thqó oóftRAmz qát mRA2

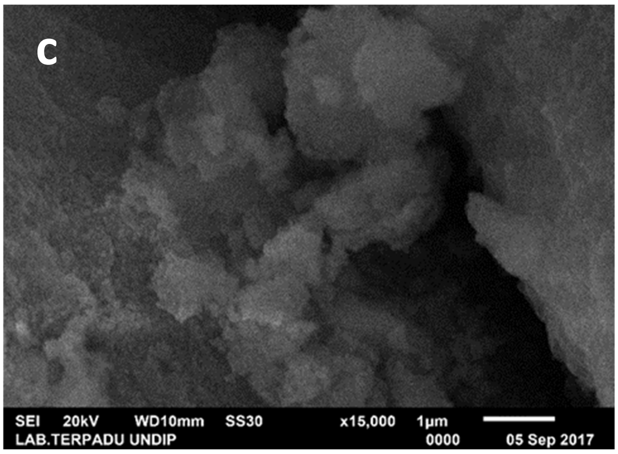
q y –óát –x-sft mz p o–z Tqz Th r qxqy qz Th óqRA Thz Thq RAThqRAqp t ftpó–fftmá mIh mTh y –xnó ómIh –r Km mz p X óqmoThz Th52 ; C52 ; mz p 52@ mz p RAóz s RAqqp –r 644óáy 0 fi qóq o–z óy qp ró–y Thq [MJ y uó–sómát pmThmRA fi z uz Nu282



Nu 272 dZL ám qóz –r P I á á–fi pqóm RRóz s RAqqp m 7440 n- 6940o- 644 áy 0p- P I á RAz pnóp QL L 4514; 8185; 6







Nu 2 82 [MU y uó–sóná t –r t ftpó–flftná m há –fi pqó m 644 áy mz p Thq y –xnóóm –r Kmmz p X óqno Tha 52 ; n- 52; ; mz p o- 52@ 2

q puny qó –r t ftpó–flftná m hoóf RAx fi m RAmoffxmp ffRAs Thq [ot qóóqó-RAé ffm z 2 q ffmfq –n Thz qp m Thq ffnóm z –r Kmmz p X y –xnó óm r–ó 644 áy RAóz s RAqqp0 uRRA-fi z m] mmq 52

] mmq 5 q puny qó –r t ftpó–flftná m hoóf RAx r–ó 644 áy RAóz s RAqqp

V –	b nómmq	
	Km3X óqno Tha Th	L uny qó –r P I á oóf RAx, z y -
5	52 ;	672@
6	52; ;	672: 6
7	52@	8427 9:

q nqRAóqRA Th-r Thq RA ThqRAqp t ftpó–flftná m m Th RAóz s RAqqp 644 áy mz p y –xnó óm –r Kmmz p X óqno Tha Th 52; ; 0t m RAóf RAxz q RAq m–ff T 672: 6 z y 2 q y qnRAqy qz Th –r qxqy qz Th o–y á –RAz , Km0 X mz p y uó–qxqy qz Th nóq RAy y nóuttqp uz] mmq 62

] mmq 6 Km0X mz p y uó–qxqy qz Th –z Th mz p Kmmz p X óm uz P I á á ó–pffo Th

Mqy qz Th	U qnRAqp o–z Thfi Th -	Kmmz p X óm P I á á ó–pffo Th
X	5; 29 9	52 AA
Km	6A2@7	
I x	42@7	

q óm y –xnó –r Km mz p X t ftpó–flftná m fi m RA RA ThqRAqp ró–y XKK –r pffow qs s RAqxRA fi m RA52 AA2 q RAmoq nóqm –r t ftpó–flftná m á–fi pqó fi m RA t nóno Tuttqp ffRAs J M] mz mf RARAz p Thq ffmfq –n Thz qp fi m R9 92A6Ay 63 s 2

4. CONCLUSION

Q ThRARAft0 t ftpó–flftná m z mz –á nó Tbxq á–fi pqó fi m RA RAooq RAft RA ThqRAqp ró–y Thq XKK –r pffow qs s RAqxRA ffRAs áóqoúá z y qT-p2 q ffnóm z –r RAóz s RAqqp pp z–Th mfq m RAz u omz Thz ffqz oq –z Thq RA ThqRAqp

AUTHOR INFORMATION

K–ó óqRA-z puz s I ff Th–ó

. My mxBftqpy up m2mtuRAxqoThóqó2ffz óuho2p

WZKQ

e qpy upmI ttuRA	P4444144447175851: 859
S –y mxnRAóu	P4444144461 8A97169: 8
S t mxómTh	P4444144461A87; 149A6

ACKNOWLEDGMENTS

q mffTh–óRA fi –ffxp xuwq Th nowz –fi xqps q Thq S qy qz óuRAwpuwTh mzp a zuffqóRAhRAZunff r–ó Thquó z mz ouxm RAá –ófThz pqó L mz mXqz qxuThz J qónmRARA–y áqTdz RuL ZXU mzp L mz mL QXI a VZQ

REFERENCES

g5i V –ffqRuRny nóffz 0[uóxft e fffi mz 0Zm Thm RfúTh0 RFy óuz m Zmt nfffz uz s RuA2 [ftz ThqRARA I z p Kt nómoTdóutmThz Knón –z mTdh I ámTdh Nó–y J ffwúTh] ffu Tuy qRAz q0 Xnp mz s0 Q2p –z qRuA2 *R-ffózmr –r I ááxuomxq Kt qy uRAfi2 6459C8, 6-*

g6i I ttuRAe qpy upm0 Rny nóffz V –ffqRuR0 I óuqr [ftffwóu0 V ffó P mpu2 Nhouxq [ftz ThqRARA-r P ftpó–flftmámTdh XnóTdxqRA ró–y K–owxq [t qxxRA , I z mp nómsómz –RuA nft P ftpó–Thqóy mx U qTh–p2 *Wóuqz Thx R-ffózmr –r Kt qy uRAfi26459C75, 6-*

g7i I ttuRAe0 I póumz U0 I xmóuRuAK L0 S t mxómTh[óu Z U2 [ftz ThqRARA-r t ftpó–flftmámTdh z mz –ámóTdxqRAó–y qss RuAqxxRAnft R-Axlsqx y qTh–p2 *QWX K–z rqóqz oq [qóuqRA U mTdhóumxR[Aouqz oq mzp Mtsuz qqóuz s2645@C789*

g8i Oqósqxft Oó Th0 c nqó Nqóqz o0 Tffw oRAQRAz 0] Th I uxm T20 P –ófi Th f R-AThM20 U ut xft RffpúTh J mx ttRuA KRuRnm2 Xóqá mxómTdhz mzp ot mxnoTdóutmThz –r t ftpó–flftmámTdhqhró–y qss RuAqxx2 *Kqóny uoRA2 Tdhz mTdhz mz2 6454C7: , 6-*

g9i [óu I RuAtmU2I 0f mt qóffppuz S 0[t mt óuttmx P 2[Thpft Thq áó–á qóTdqRAr pqz RqAt ftpó–flftmámTdhlqfTdnoThnó–y o–fi n–z q2 *R-ffózmr –r Vffoxqnó mzp Zqpn Tdp] qot z –x–s uqR2A 644AC: , 5-*

g: i b ff L ffft P uqz 0L m- Y ff–o P ff–z s 0Xt mz uV s –o J uot 2 [Thpft –r Thq r–óy mTdhz –r á–ó–ffRAt ftpó–flftmámTdh oqómy uoRARó–y o–ómxRAffim t ftpó–Thqóy mx á ó–oqRuRA *b uqThmy R-ffózmr –r Kt qy uRAfi26454C8@9-*

g; i Kt –ff R0J qz IV uRuRA J 0Kt –uI P 0c fft óqóZ 0Oóqqz L 2K–z ffqóRuAz –r o–ómxRuAp Th omxouffy át –RuAt mTdhr–ó nu–y qpuomx mááxuomThz R2A *R-ffózmr –r Thq I ffRAfimz Kqómy uo[–ouqTh2644; C87, 5-*

g@ [óuámát mX20[0 MTdhRuAfiqmy a 2Q ThfiTdm0] ffz wnRuAu] 20 Zffwz nsffx O20 Xqz sámTh S 22 Xóqámómthz –r P ftpó–flftmámTdh V mz –ámóTdxqRAfiúTdh b nóu–ffR[t máqR2A *R-ffózmr –r Thq U uoó–Ru4áft [–ouqTdh–r mxmzp26455C 8, 6-*

gAi I pmw U2 L0 Xffó–t úThS2 U2 [ftz ThqRARA–r V mz –1 oóftRAfiwz q P ftpó–flftmámTdhró–y L qmp [z mx [t qxxRA–ó J u–x–s uomx Q áxmz Thfiz 2] *óqzpRAz J u–y mTdhómxRA* *I óThoumx Wósmz R26455C69, 7-*

g54i e q–z s S2K2 20 c mz s R20 V s [2K22 U qot mz –ot qy uomx RuAThqRARAr z mz –oóftRAfiwz q t ftpó–flftmámTdhró–y K mW mzp K mP XW82 *J u–y mTdhómxR26445C66, 64-*

g55i [nóu] uwn0Rny nóffz V –ffqRuR0[ftffwóu[ftffwóu0I ttt nóy mz f qróu0I RuAx I RuAsu2 M qoTh–r U ufuz s] qy á qómTdhóq –z Thq [ftz ThqRARAr P ftpó–flft mámTdhnft [–xlOqx U qTh–p2 *Wóuqz Thx R-ffózmr –r Kt qy uRAfi26458C74, 8-*

g56i [mz THRAU nóum P qxqz n0 Wxuffquóm U nóuRuA pq0 [–ffttm Tffoumz mXmt nóqRuAq NóquThRAU mz RuA% P qóy mz [mz pqó0 b mRuA-z oqx–RAc mz pqó Tffut2 [ftz ThqRARAo–z Th–x mz p ot nómoTdóutmThz –r t ftpó–flftmámTdh áóqámóqp nft fi qTh áóqoúuThfiz áó–oqRuRA *U mTdhómxRZqRuAót 26448C, , 8-*

g57i S –z Thqo RuRyAuz wn0 a wómz ottftw U nów–0 J mnu 1Qfimz u b qRuAn0 S ómv L my uó2 [ftz ThqRARAr K mxouffy K nón–z mTdh nft [qy uo–z Thuff–ffRAK nón–z mThz U qTh–p uz Thq XóqRuA oq –r L qfThmz R2AK *ó–mTdhmx Kt qy uomI oThz 264552*

g58i [Thz ouff O2I 20[mz pffxqRuAf Q20[mffff J 20[Thz ouff [2O20 XnómRuAqffi–á –ffx–RA S2 U2 0 Kt mThuRAfiffó–ff d2 0 S –z Thz mRuAu M20 S –upuRAX2 2 Q2ffqRuAmThz –r Thq P ftpó–flftmámTdhqh Oó–fi Th –z J u–no ThRq Oxm RuA[affórnoq2 *R-ffózmr –r J u–y qpuomx* Xt nóy noqffThmx Mtsuz qqóuz s2 644; C5, 5-*

g59i J nónnóm P2 [ThfnóTdh Q2rónóqp [áqoTdh-RuA áftB Nffz pmy qz ThxRAmzp I ááxuomThz R2AR-t z c uqft * my á C [–z RuAT ThC64482