n 痃u?賹 2cmd>??塒NG IHDR 欈?┌sRGB ∟ pHYs.%.% 叇Z骀鏂V謻?... 嶯螙枛m鄱漶 └y h?< Za?に妁ト?Q KNN瓮蜕侍释藭?↑& 灍?楏LLx<> 巢瞝韑E"S 「粌 索袟pptr捕?377 ?匓弗□鄨馫♬9篌e2橳"◀婧iii? 缮I饳'¬☆栌◀钵ィd玟xzy桓篥[?`誂●〔挄?」Fě -,- 笑?壬汀^?yy┕y?>?綣(凪IN抏?5e朤*KOKk 性亿羳楤狟8`? 0j] ?. 6种晤忰?潩??3 ? 鴩\$孊偄榊<孊┐1叐↑闟,-凪II?頢@j WW 口-?R ?面佈蜢♥?麾賁剥藿 攳?厴H预?諉Q萚?├皠/%屢`J ?面甙玏憑w镏ビ? 絤?{弸D″沯│奟蝃Cj怾(¶ 汔薀?芙#3=Qs倓┐酅E佈蜷賉W蟏籸c?{碭<嫝Z?H峓v,]?*鼉┰? R? ? F衰7迩帪紁鶘炙洞匆:M@??芙sG霐 A聛娏□ e 覐紘♥乕捴宋挝?ML鹜雡: ?♬↑;•□寲0 6 #蠗I?-⊤煓檯遉 煺M维 A聛娏 ¬ e 訌癛钤簠祬?7 Y譳菴捊瞦€纇呹窦? ?0 →↑!?•*┴•□孷滎 RBoM??`椊&¶^聛势¬?で殴管w榅│洖?^櫣 5 圀?: 刋. ?C廴~?0峝十 0j? /' T??. } 禄y ?聲?┤I08P?@`詧{▼烛?iTLIT ??k 溪晈?-;G夒h賆GrUZ u★R?bGA困Re!? *9 寲↑隹/G 5 蹠箔坿嘷+▲O A願} ebR朏! 蠶C4ī 鷧摂?F? e 觤?鞑stm邾m俊┕b?J[遛) 鬦?·· 綄朏‼摀└?Fv柁询f齎鞩鑬5YH扷:♬┼↑-?钒矅c9│ ~J?│?8 ?3 銘A蜾続→U筍鑇橠 溋臄悢 c) 榩类9@`??_&伱特
「?_隙q髚←q矜輼膁o0忯屘倳c}熨 埃Φ•?集r 廑?胆枝 う? 贵鳼d│ 挖尘[p辁瓱W 诖Ys懇E 郧贷迳&R6醼as€ "Rn? 骊Q胀 J 襌So\? | 越癜敂d +KWg'/0/o//[[? ~與 |6b8龄|K? N???? @jrRRt111|<葹? : 玌k弑s攵m玏?H'. 鎐Jb磧砱??L8`? 0Z>? 灬]?啰?+++6& 藯/?贷?♥gnnno 榠miaac / w飛樨廖?<鏰G<?絛2?盹23 哈rs b =}V 頂?8 陨俟f ?●4h厝痁5u? 枔漬ie疦b拞p狉p€括钩→Vq?5蔞pzZZLLLtTd,鄈TTRbbjj*爉nN ??絲{zy999棴t K冞?痎玅俨揬?┸?┛F踮瓑q 蝞>% (h '/仝佟覢-∟潩1m? ?帴 b舁们0jN?厛??羼 | ?Nh I] ?齚(4 蝃>p湄狛}@D誾 } ¬唫nW霐 A?c慒跹k RX藍U---徛斔↑6h圉 v?U隕?▼[纱N笵俌├9孜酒?巾萁↔芙↔A吞b朴•▲A 鬘Ptd rL a? ?煋?淺醣???↔緑?8荿 M崓晥sL偷贷优?>*yD???各 T € 敹c鷒vq洱u?]癇 H 瞞N 狙┬?I?陁郗◀★?C 祸↔? 鸢0]4蛰?0 霳?~″蛁S? 僖裂晟迂3G_K?h0v湗h?蕆 路?疬蠽evo构u用 rM價 0閌墝"t?: b? | 肱偻隰袃A ┡6 磉咧瑉篾U?藧→□尔飕T貣Z唱歞鵬A └繌< | 鵞馍€瞴誩 | 德? \€蕔蜽塜 o曻H% 怶?7'+ 溱杓pQt)抛慂丹?m:助 A;嶮←2?\$強N. 菴??¶缂¬??窑&edg?阓 | ?A ? €]%6 bu袽瓮蜬嶰+?4 E氱%0? C ? ? i 簕诨纲A殑竘?16衽磊臉?{▼?炉?n鹬巽霾 醳哾{盾」-г\$胙b 坚怄??/G 纵?循?p XS? €f up鸧.)D奛繸`¬? ♬w. 績V ▼Lc1J剃?瀷s%P钒?*?}¬\$栎嫦!=])?涸)懤?₩*]→X让?C BU杲忡U?\竢镽橼 镞寧J乯~>穩呜装捋頭 齸e 鰩忄?oz 俿s桍8s{薩├¶吹7軜:赀yS M ?軠馦[根?U? 芨?H刘→鷗頠?;W ~Oc^ ?<灄B竴饹暀腙^聠4LA?={?\€z攎 貭V? U颦嬉袟└鴦?↔7莽J璕∫溢M> 讽▼y檠?螏st秥??瞫Y篽芉SS岚gm貨?慎‼贷}; {?]?4鱷?~視凅g烸├8 鑫↔?譵鼘n泳?鍣- t筭 | 9 ?:俑D駝 | 蠝追U麣旡b駻+N?忷KH`T浖-縵q灐,?m、厠^絲q庳Qm6次 | 惔 I 蘭犗怞ruT 楈斞□苡矶f苄?W 歍 碷-铧磂笅噠?乨k秿舁?Vo : Tgd洚? -苡?hL藌嵻?NOQ ??V应f?{'? 恒崑*嫴|m 錥C y??h唕ぐ 走'\$?炒w?>y?4箂罀{7? XN樥「?扬寿苡Py袪湽3o 络麸¶?楈蚬o+4墀杓@(. 盆齀雟铡Q写B+ 癸▲5懍?岥+hf???{o伶=‼v燏 阌ml 9鑬辒*%?钳}7k~?sz?3蟪 蕇i? →R偓}馄鱻 ほ M??軠?醢▲芔i?0ZZ??59柷‼鳷5爡 ?鬀哪?箕覼?┤倉瓸憏x ?珠肫?oˆFz {[t隵 ┼Aガ庇¶BS裾郌*↑7漽傲?沰賊?P 閲W │俑?指)]趙>掣X毊點 S酦 啖 - 郯?衹 染1屠Z 絨 椶┌衻骠]q嬥s?=Z碪?●歅H9r\s? 摽刖箐\$曎◘鑰眍 '痎F}芳┤妆 JL?婇諞 ●;Gk乐 ? e镲 ??2 曝; X鈐」答└??h(n縣#`盍柯坠K ??鱱|▼e濒 ~t棵= 苣o [sH 佩唆瓊/?郬¬?睭?aA ↔輯Y? 聗M礹?迅 C\?淊註Q?遤 乼隷沇 V汪|擁 呙Φ颂?芜?清+G 歐←?h\$?r挔→箥* 彿枳┌√嵼V/=薇幄&具♬腭?0 /→w頒`渊 華?e"G>Fr?S? ?埄j 「??)崠w3喱yK?[检 ?3哲绿L莱[□└訹枧?寶翑@^%p蘆F綖-U 闷-h靜←●磍酻繛蟛 z y榓Z fX—X垹F-逋↑? ?, 班 岼?"崠奭ZH靇334?, D鑏S~娓<*┐澡騗跼?棚 鎼:●nL?祣?. 爓 ?膿莬LN2宋敦緳扱S抏鹶fm???齛URp5-詼%辩?F 蒙M(釹o8J廹bu鍍Yx2? 瓽`T汱疈碄羝揋麨uM蚃酭b? 0 瘷→偆掩 OSO殯+?_zT?饈鲺?&< (伒 ?гi?;踻领犽棑 ? gna绸窂€榦 巛箲w瘳鋍?=峸p弲温?耒铐蹆 OK妄龔 ?m ;?K瘟 H??*忘忞┬??濼*&O 盓?'♬┤?愜U蠆?} x' 琎K?萆Y栝m譅 1刬皚|? K0睠镓藜?懭噹??→哉?.F ″瘾. 琑?裱\$<旂W絼嘎?222b蝤駁N?m? { ?饹/栻/}+緤錕髖┫┌┼鵴|?┯詳,?g< 」 0 N25索驏剣玌W覎V?o衣v鴋*Z香鹖跃@▲邊g箐a ?桚谫蹷→滃[?2"/<攤Q擢 □擆0€Q諛鞿1昘,^ 椢?M??0虙.:cr猊┼忸4筢醅|畫`h?iT媫@H 6 太?-FV {?綢KO?屭臙嬨悚 {督党3崐锐 → L-↑璟] 桡藦 桽襤5滺?! 寲C 练o?>xH瓪M -₩?.└Jグ~珏IL?涇└钄??型\$:↔ 净-e? ?>槝L? 芋♬?E 厉i資2J ?0*茓z怓肂 揊?Y簑?M浂4 糳?瑟 r 攒寵G簋{, 愭 ←yZ巎 ┴┤'灣┴?1 楞?S 佈r] \$sp !!?#└麩昤豉?S3辆↔/?蚶en. 殼x軮3 0歒钳篣└?蟀惣靗節=咦?仱血貉?y [服癏?鷺 鶅牰[x甬椊彿[??*暉?鸩 "€|j. 銲d| 關蕛鄒<"□ojJ`?F)R ∟ 0??J尻 閉`jWR掓媛^?0鼁训斾祺??, Z大欛]搥f无U, 猅祒p'莽 ?b锢薍噃?♡0?昱

覚爂打繖t咸?謡p 醌N{酃贵∟?嘙]?詧---箟X& L 衄m″噻?-6% ↔??D {??y2灩坓c.h鈓鈊)疦|鄲蔃媄耡↑酣3 脂?}L蝉0 闇簓\}2饴?▲轛m:胤n飌錦皎 毜t 欜匓灖珐 uz絓ォ塤u〕 裉屯儏9/8涯? Id譅 彎潎馒蜼?◘?楀HM噜 ◀唿玍 坐切簥软?ト佈?[=r€括▲橾牗屋y枛级?鳺?ùM騶!!yF? 建↑滴F裧靫W ゥQ/ €Q]濔暃?↓懶c3x諠?煓貧 | 戾2箟橮?5 [穿懂 jbm漂??鄝3? 捧幦蠂 ?崾撍 ?↔s€括?₩↑ c? ♬韗r69y誮齎菗W:蠽 斩‼溌-? 歟^?毙+?畐騔踤介忱R挜U i45 拍瘹瞍Q€Q3搶溮紌章 /n og麝→E€. 鏭!?♬攩 UFK?潷 |%i 镓?┤7厥NW%v挛胜n面e萅?♬↑2 来?昝hQ配鋎' %%徘臙GG瞧凢G 吥荅&%%浴d儇餧₩」 &^AR@X w懌 ?"~¶eV因9鮬1驅┆%捾c欠?Z蝊┬妤遄趋楕孓褢aU黬•絳^ @i)愻?-?┐?u愭0ZL耖殚 耨 眖Q裹毖!11! q?) 萸y刈=险E铈&鲷弱疣够 「回mm羣廣蛂?S? ?凄⒀朊 [诩曜弟詝{鬸盾MX 匥┤篆WO-BL⑷祆屧剺? 疐齊??● ?」F5?澛hQ5揓ォ--- 榔牌李鯓梓?? 睜"0 /OG櫅KnT岓贏0i — 剅摝旺綦[*▲|>?fj銦?珏鉕鵧 FK贏捸X8@`Τ *-|↑-ζy构I蒊q眖II壿瑚P縨匤jg曜&珏 呤p鳜"2+|K@噗 Q*畳腇?b?妌R窝f骀灋^μ殧 C榨^D贺桊 欣缪醥y<緩 恝0 r洑懗B5d6蒼? 0猘 *, 垎找C鯴p;?策?D%贝vpv笱C• ? 鋩`戊Y X-clnFzrD然尨勽茨焯悦;柧x 赏┐?挝.N挝NNN 帋种6唒魶:貉靶PS?\$饀鮖 ? #茟虅└!?」F5晏耟碊?爴沦飕寽??фp质授苈晔蒑B鹒参.. 嶯N鲻鰛縫甛塂5LP 寕鐋rbLb\劬厖?D?/??% 説@?FK, ?旖¶└蝔feeH% k [豈」8{豸f乚3 ,? 鰛牜 G吢(驕鲏?|蟳0 昘?!!剣捡璙纺 d\$ 醼qq€括F?€?|)e%(湑JA溚偯;33?皎暤祬??疅?8 卢硴3杇гgK韵ra旘淥K垑T驕/e ON`T+1\$D ? F 璆碦▼Fm悧M沙櫾桑€ 硸栔□gA?蹨耏g GGG繷?8(v1?友苔FbB1A蟳璗嬂 F豀?→●□宋?`L猢me?韋?瘠蘞?任 ¬¶牋 U 1[^]煔W伬儿<\$¶?」F5?c呇? 骊QU#v敕├?售CK藺↑+♬↑>•碻70麱? 「踺?铡Vx 偂e?蒳? 0猀?鍔^?k? ??? ? F 瞇剩RN疄錛,)損黎9@`澡籔[囫 澂躷仡IxA8@8P -- □親?r€槝嗜8捦?@`T) 彎?U榙&∟ ∟?•□来芌?? Hn聛 ?¬? 暂萤? →聛娓 rbb舀▼+拤I#F愄?唱 LD Oj 荬廕阛-{S^ R%耄KH F? 襋 ??喪┌?鮈挪nW滧→u*蒐8PJ -%?n蚰窰]7巫瘞畫 ?●粝┌ z 鐈%. 懩-漘仁N`?w 5嶌??![⊥]?●□来腅怵?鸋f聛 ?┐??笛□=8 噞 t 頢稪?‼x 褉N鬆. 彖覦, ??原鍶=澰3€~ 澹聂=t 衉蝮髶3scR秤s? 5o貭螆雁5b:? 绒m㘎艾k?崐!□:究洲動▼ 瞭达; 騊?吏鞼 d>>朸瀻+7 +日↔氙絰↑?糕?鏂f\俢鷒-1y 俸A媐└?≤大6晷碁J箑潘f熰R僤 e \??焮姐r娠?檡,!1}缟I,YP 栗??L;2 ?;諅?L〈赉_窂鈻♬?i鋷├遾m之FA 釫綏忋臛嬥 W?繎鱨桁针?k0?4?~?稪#縧nie:u灬篦 殙竏7龉耦璥?f询└? 4 醺-*真?荷蘚4wq? 8 WIvt琮[W僸鮬嚠?¶z?M@蠠鐫?d?M 嬂?*2嶖aT. 弿 KMN舢R%饬酹?<緪?@()綪? ?┌0(鄫?亪/┼駝 ?s-催⑺*桰銻I> 枢30. 幼↑-*KNI]秜腙?C嬺骵 M?龣檽?\$骝胄t盶djZ璅晭澺絵-辕g徻鯖k膖Nf鼧y 蟈豐 +¶\$籫送s '%? k驽泗醡艄鉕葺挺烷 蘿H 閣‼☆@霰于詎?廪螎??+鴇b 箙i玽51?? ?K 堻i?Ss ?7?C' 舣眈餅鸨}相问MC吞M竇踩栲d?燡Zj鰦'▼佈8 W7 縱?(谡莓^#煒 "w X:軘?~柺M♥.絢?↓€?` 齀椏6n R' 罈蚒(恫开黎懡?誊 繛?[⊥]?0*鎫Ea(,?5珰?┌nH 承 | Fq0礿 鯎?`詼?鳇 鷧@阁泮A栔⊤寤┴↑吘{|/Be娐鼎弓a { 绥值SS瞤vJ3螜'⊤M?r骹槱 ┎镟&U ?茲:鮭啢x€T钅箬V嗪.瞧鎮睥zMw栊SG .j81\ u?丵u窽d m?8 ?絾q漕? 獘??d磘0 豘昂↑1 ¬ 达=□婃塂骀f-?n吖u@搯€?▲"∢?).侣沂A#?檆>&甕|?鱐腖X?0鵣PH]q 7 ??牨蹥m#YI ?淇1 .4 ? s鶗?:雳1`\$嶜桹< 捐不 帲觹?AJ塂秞鳋c???F宪瀊ae?? 9i虂鲰?[??┐傿怇峎? 0簕送瓮▲傭歬濲孧 ?悮?. 屸 G巏蜫緪蟒调呦?├?9鉂0甑} jx送 鲈堅渑!!€ xkBJ澕 B 嶚 璝畚黺預敎廛W儈莶h 缪u 7緄媶軄(摶锅8蔰b 躾Tq唶痃啕?」忯?莂徘謞藲葵硓-坊走稆?~噟堳餽€ 焺銛 └罻 :甛 咞鄌」腨 ?g幘喯?鑻 ^"惏?绵? * PxVY 厰?x羐V&厪?2/鋜v谍i?尅餵墁陻?U貛S满z?C1喡 '「烠裋‰鸘|C醻揤>包g晽7/紖疭~鑎¶||?/Wr篁 [繮囵 緃蘠(┼;藽?嵙↑ 界. ?? 粖夁佥▲孬? 叔€∴疗臥 缼丘9踣^,拶豘 s4?惰u+.凍`鼘n,哛糾^u鬢↔T 喹OU琪 谹蜩n癬uW狆擘撑? J`T .i9Mvf拭蹢饴???%?陼I鋄Ks%鍤咵蝤″黇搸 鵪└{ ↑'K鲜桂鹜? o;烬鰏椇U綹襞諧 ?=弑軍 鏹 0 ??报臟晴?∟e h-賒a辽p A栩y嚬镨H掰q词唬jR |~騣?+└?i`M蚆in!垄n蘂??厐♪?氹3 烞┐X淶X*桖 ea:廷Z1? s? J → - | €嫌☼g\v2 8敒?贷? □ Ø - 6 q 橇o19.?鼂0. 堀抹←椷価•(X(隟1T籲u牰 腙*5yp3 钤贷?巜 \$y|?圖| U蚝z9鄶矾*x暆曶镦?栊M误€瀞'熻踤!!T嘏镁T俟?攣┐□} 疭8陚瀜銡s i p襜R{酸H x<0?g畩-抋? 跚%. v??孊*D緶A夀 1笒灃摸」齿秿?←餴S喹802eN/v怢 {?J儰xF -驚*. #棹?亏 J頁??彊?L x凛 7 ?NN素{骀凑劬 ? 聩 ?└鷉曷!-:殖处?j Qh2GWG 口 @¹篡殢─-餛<←A; ?x7 磙 用?€6? 摧椢?撟椕6]> 磊♬?濬RVt曀?i閣' 聜↑ ?8Bu頤腧厀o炓*1H秗???◀脅弋1?柰_┬↔?Cu*厰鸽A{3杆?;??磔 !]??V 竆k;?昝蹣 n{?"59膻-?9 {聨倱tQ?桗B8篪罸p??8 ┸LJL ?[[;p撎赏MOKKJN23 ?糭品?:??8v15.蘔?Va?B 問>?¶_p(`J葒攙"抛姏L1?绝紀 j酼*K 餅c梠? 藭H?疌蟟妄祆瓂&¬埊熰u ? `?桿>u嶎€g ?D奏?7?!?Y暄5缉 鼏疘q駹駊rU? ?鳺1,fS聯 mWq1?U ~▲?篈?) 鄟渲剈. q騰?曜凡B??砾! 漯嗌离/熀葒 駕潛s糗Uoo蜂?s+覨m?孵玍莾蚧B鑹K??} 狈柄↑ 盟滋(®) 嘈巤z卢龅→⊤幾`┼ } 贏銬J5殍1 ? } 嫌 U繺\桁???久扉-篜grH [{qF悑踭璢TJ慚 cs?N箆蓹瑞TnAE 连袅?V?~WE?竩?撷↑↑原爁荽??疀厄 | 5?轕鹩鎍*铟€挍譢fu邪w榔NIg ` 灦鞛z | (+佝\~b?靨赕a3)~w饒(qQIs ¬ |-砯]? =?mU}d煹\?俄o焼o]w -t ? ?螠鋽?3PQ 1?樉 鱝束 ??#豏棳`?e?旿CC倉珄t Y痽┤@L 呂¶"?F?咶赱9z簓鶻X?3F蒓 Zv}= o:w砀¬?)7?1瓥?p嗫;泈♬+j*-[??畏惱缳♬囧栒峎→?昙箂?赆_?↓'Y . . 癶II??{ 钶 ?鏞 鯒7 ?氈哉軦 ↑ 鑜m?S[?寠榖xY???挫?1 j阵LI授鹃甓? 嫌聺U5h〈佈"?↔?绳" 胔rr蕎咛馨鮳V €W?F?9鲞?&L炣 ?└●纕 - 0 ∟筡→トト緍?●0羳蓖┛B慥ぱ肛?┤o^絫銚摭z? ?Y宋┌Xn0 |租_-?豜? 湢Z絯焤 ? 皔 . (睐_谜贅T +↑-均┩ 阎鲋矧?__¶K 悄赾u*喲{w 1鵙] ?髋XJ陻?鲭s瘌Α€Q??In呒絥韱蝺敕頭 貉预鬹楊^絫Kh瀇凯Ψ冎^ 贛歶.?%?●侍 Γ堊跸▼ ?M; ie?"? ? Eu刋?嶭A瞫芨ゞ €三{鱆虺簎嵇钳塍拟Ysf汗?K `4.I蛭鹽真\i茍蓾璴, 媞x适然w睐?忩墓┌愍7n 萜世侼*顡¶猫蓢→?T? 让@狝8P6 -乷●鱩}‼t!:?披?v 帤旂&缚?ト遜↔E檾碝渦 e? 譕匹¶‰[~]犺‼英=C 譐7槟磱[⊥]?/ 屬S曛 ?憜攩?}z zpg旍%?d 区Gy徱埰?¬Fqb粕灺a攱鮐叝(▲3E崕荓{廱瘂浏妹爘Ni鏤茝?↑桸Y鏏→Ep

?+冢Y -:譽v硶鍷 [+盙j?* 甎?丵5F Ib< ?曬??」F e 螫?豼r鴦畭[諕驽?贵 谣bLDA?焲& 儍 } 靗贷橝w填氅k蕀▼A)6琒H 埳x鮏┤?鋪?騫┬\(C?v 褨%?T ? ?琬?┼?↑│ "‼o鹲 DDtR\Z嬾踣ti戽韈茭)脸 D 5 玔籲+M橬?♬↑↑●在吃H &u? 亱↑ | 萘Й郖 ?畝覎↑aT嬢FH ?@'F ?鮶p?蜥?胔1?醼v8@`T; | T@ 疊 「F 0?孷€馚殸 □F丝贷?斆揦贷 xr?5?'招Ĵ•□宩墤芆-″→穟r馫塜* `j?凾?♬↑%c冩, 隀□0 ?↔惏揮#'腇¶镅递RW逢崨v0嘲-挱*jU聗?沌丵 厂舷┆{q夫??综 1.櫣澂_}遇貔│ 闃?♬↑!!•◘?So榇畃N}?│ 碙I抷f?鈏Z峧_Y鄹誱厥瘟借僃 ?窠譱'↓忮?┐ e 聉 \djY?鋼-Lec 蒭?0j罎 猶┤鮻э C, t -? 墣 D縈蓨憶?8: J嵧v} 餄僵汙h衢S佑??衞 i?F? 鳌kZE躜? i嵑「歊台?躧)∟?◀cHS崠└dQ痠?z鬑S ??列收邥〉」F+C/ FXg珱挫镠瘥換庝 |>咭授谥壨?♬q槿 佇T ?M聛蜮丵M9 5虀 ┌祾I? 聄?蘹8@`T泳ruu諗」蒓8@8`? &&c?m譣☆ft= ?z?%p€H ?8?W\$= Az攑@? 0?昧酙S \$?醼1s€括 G ??蒓8`? Oj?ア觌玲I Eh??酅? OZ2廐 ??聛b8@`? ????@`T#鯝f縥~殥 ?●◘●寵└膐詞{O踰'N澸?)8@ M?-9VS 8u LW愁↑!!●□宋赱gN澰?蒓8@8`? 媧M{o镂縂??曭?-|鰜'-| 鹎挫檀?_*D 藥 i Q燪?遀? ?蕼赜憠穸⊤VvVVt 4彛吖г舁 蠡R%榱yln暘?現氖麏淟: 湤裌??恨芏髷雽←?峦M燭4?敋.?g毭剿i,〕 煼甸 eπ夬J馸U幓 3 A雄衛耐Q 盘e雲/? =纹2€篜阛e綽>?煂?91─ }.c 鼩括?d?z髭? 氼_|↑瀾ù埁慈柧?hQz`续┗ └? ?w鬢 Q:蛸r琮 o?疚~??u?????[嶀┐圣>if?悩Sz聊P j "EQ茘b开??!?├??撯#淺}4},鯖??鍂虫?%QN?藜?犲栟'施|R,醼Ĵ•Cs灿?C¯¯€簸?€C? . 脏?yX縜?髱 [⊥] u祐o柩XSv慄? ³ @B | 刓. 7 °G % 飐?鹶m訑?竺`? 讲ナ栐I 慇d. 残c]HQ??暺? 肶?=廣讓&0猭♬↔} X4%DF烓錤 ┐‼樱堺寒n洑↔(?y 槝\$ 唶?橺→;3 ?{ 猍 焯栽袱?.└?_灟.共 M嶋菼/kn挴鈖 5-.>& 腾喂¬4壚h 枘挍?←!稳;蜚箳撽8EH | PrV拵 ! ??+q溜熁zT5魥猈?¬ j 瘵鑄}?衹剮?統. 21?镐寧??●遭@zfBX蝎甑→℡?↑↓ 镦?♬鲫¶沦 Nr拞p犜∟ M寢0甅,J%6捓h?2? n^mP ?窃i儣漁? II? 攳└閃壻?蜎F禝 ┡? -慐% 鎵?t?迕 j7??仉喛刯)9悜?撴YZ;??\$'0Zd'厏x₩胷 祱└扃嘧癁o还?↑?蜫蘆袪[→Wm鎖铳隦**龜磀#mZzv繇?梞俚岑=←迖?? ? 0`?C?心膏藟0 0 欉蒗<鬸薀韽R鈉熫粰棑Q Z鍛4 &墢● 錛竄e編|◀楝q] f? ?X靛莐7/ h>hx鸔u荜]紃钹焔▼:?.研 9?I 嵊嫭∫雠? 擥?栶嶯n ? 毬闖♬炶 &r ?}溏薙S t黚xrJb?M`v? 'P^NVZfR漆ョ 避pX66槤Rt8ト?P ? 曃`┐鍏D 煾 x绕芏C兾亩誉\$Rc 痞,??0螨雸?垢C m毝嘲癰⇔Ы√J牸滭4p隘0巍?一戊Y歁朏?,?0. }>:18C(rBI2■ 萋}3s w@罽搋\> ^咕梨s琺↔?歼窱髍?8廝rd嚃渆•鵗▼F3蛞犴m铮觴?I岫杤鰱♬L埾″銔*B | 鈏€?└o?頣9 *b@翀?' ?o???0Z\糛&P) 毊擟扁X珚x 雡, 佲┤跳&?」R│ ?. 閐 檌颿^?t H k{=鬡QE€. 律謒 4V ┆?J? ? d IXDMH峽躐eXBH鉤「]邝瘐甖巃涹L2C齤↑S {M炦J?!镬鞚灋♬17詣^怀┼I!(FR L ERH? 窗耕难IIqu 7泱厷鬐├? 紆瓎 萁 弑偖?F觬R觭营8 Τ 旿% 万*←¶→墠珼囧5 睧緵I?y?钄悍鑕ο鉆+擩9得€?z ? Zw晷獡儩#↔?qY 扬髕檿d-?瓡♬F @?湡?17 ?凱」υWv靄譞. &Fh擲撰♬.▼讅13.暎L&?__tT笗嵉g嚥e?d箋鮎輾嶖,)T鋳ピ? 婨襙♬? \$●k *-J櫃澭 {r麍埿歶闦俋〕壮{帆 ?? ?Fc遥?c {5雪4J蝏b鯏 n?茰箉┗¶?埚s抱ጭ┬ ┃├5採癕蒐y ?41竩蔃?醍S 钗b 3 \a鍕 h氐; 2a-J飰?玭?J?w MF=Z 払→ F{Lr磛莫TFt ff艰6iD\\T沔 ¬憊狒脣鐆譄蠔侼?芨- 7狾輍Br軝?`若j圻蜕 褶纈収 ;5 血墲卺221″0 \ RVB蹡↔憾镱钼 #砟?d!?X??淶 | 吩荄 | 儓↑ YJ數\郘囖`歆?舲榊阝?乙aC=蛀控C.jy&穅]oZ 供%鏕, S餌"讏g? 2?r ↑→槤慾?1缳別▲←蝠凤檄?暃銈??K=? 餌玨箚{疀€馋C K}bJ箩媨邉缄莓 沪澀璴癇↑F#?@? | ?0 類! ¬栿¬???*侘?F縅鵳?堙 嚪/璵,M退↑? &? ?彬菗唧≧? SJz蜥他_●胯菥 ?輑 Ph ?1 **清**#¬₩ j 騜bF#冦 →w睺gjGH? ? *醚诠歴 W ?o ?界袍鐮?鮬酩链?*橙K蚅蛋偅??4伈蛱[| ?懥种v? 檲瓴玼F龎LC? -z ∠=阏寳銽 」x讦D洃↑!!!!覔襘P屽榱畸 ??Bv%EyI!讅│ ♬0z劀旆=?→!!←栅e汻↔銜洕?漻t?\$爌&┘庪▼朖 轴锳?/G o?暿?z 楝墁屮●Uq鱁 亓♬@¶→'?琶挶!Q vZ}墪橍€脡¶ 瑠??+a亍馢 q Jy~Tb磱?逥€n#??a1 Ⅲ? 燒fuNL??黬詂み"'棚?YV 脓?澏a 鈷\$g'謗 S 氵 D粌Wx?愒.?搼?佰┼_痡4€?J K璒憩'夲S;T錭RXXj皠'钛礧做]m1眸 >, 謵?5杪┐士債?睉T*缧b妮 tjl?gg~剙慈 + Q實匢 「J2)-ZR xn菬索, 炐g毬腄矛轮T´蕬y?鈴As篍莬 蒉山修 } 蔙`{h 雟往^趩Q\瓸? H]Q??沔I ??J??@?岕E厳F映??洊欪I彙斋誀?m茉 螅:K;得巜 ?'-Ef?缓 梵I?豐屭J ?璔7?p?? =屄毬侣:衢S乪└重? 0 4J癁槙5斥F"(z?斒z袈K垬●?絫蕳c?>箦?頭4憋4 霸#□)ト鴼ഢ? 2)侈?ン?搯晩↔┴→藜M;々猬闱wo W叻? ?寕4殧 wFg鐇4?芆酾vmil→??鶏D ?at 翢VN 袯▼1#冄じ 懇y覌gχ =Y e?躈vM彛KV棠↓#▲a 囱€ Ku糔?~釪?%産;)[⊥]?锔G勣劸 - 68眝*→[◀屢颂疆g 胰磸忋▲趝y~髯aS?D\$P??B瀴€希>?0oQ K韓″撍A 蛼″速銂窞蘅=j闬?ぺG5 (.??r???? n施?C嗤 t^D嚲i騢鱫fv螇廚wjW} 虅A"??u i ?熢5<熻+?¬n翝R?€夽欩?M?€????↑PuG: 蜲?t7鉯杗:=檠頁鏶g鍨揆8黣 隊.#←枝t呭>?J? R 7 /_'疾舶\竏v撝鞬;mW贼F ?€奓!!_<7?牥!!;++蚰Wm,巄锽i晶┤醮,S怚川WI?&乹┼隤?▼?縏F ^▼ 籺 F詤快?)3馻?塒>z岐Z峓¬J? GU |瑭¬!A 翨僙v瞽;↑MO埞颤嫪?K譒刀宝@摎¶J哘H ?8?Fsr@ =Im\珐bFgVH?党 n\$Z溭? 迡竎j*jh吣萏 e ~-趙V縎*vJ#€唁鳫丂旞 檓S =)Y Ji? S諧?L, 恇1攱 E0?絫`!买&堙т辧т我炁D?X襁?} 墿?姈e?/璟Eu犎+ 硈3 ?執岋5~f?煵瑭>孊Ju^X U丵笁臨]?? ?U 筇鬯瓹锋蚚貌-「Y0漏:MC猝蝍477雉???? 芥彀 鳿S{bf釽?R I 莦U瞳沐]獻u毞铯N廡??`粑彅蔫搐竸缦觽MO?t买│ A) 祤 ?└□ _0譚j劧TJxj?軨Q哖6D噝 鬢?)惰齑 霮?h?"?1??D ¶?趯翋鄋癱X ?鲅?'〈鄞Xz黕泘煐欃 ? . 妑Ld 蔦n1 邼 趻罜痕 8 忔^>ne+ィ枙Bb-[│ ?0z1圯5 訋鶝穂2uu愈-餻 ▲」I ?W羿D ▲V??瑕€NL錰)犪I弑48閬?鈶牌鏦 |Wh4襷. EZ浓 礨iK}?\Vp)纔?镡嚦W傁{趛黩▲鄃開f綰 鞂- 牘壉q0? 确皟 瀐?H腃 ?→澰?? 弨 M%琰?庸枇I ¶= €?\$臗妍_醧蒱ţ餢 -}_蓲€G.;爄蘒 |Gtn晗 ?燂蓂禈橱r)?▼p昂/闿 窀**爨** nk^: 桞貌?骠j?緌赚€柕岌F蚹粄???E嫉[髠预〕轳韜~瀟? 珰5h罭茊6涤#┼怠1S;H 耾▼{y€'鋡蹶

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倮?┴蹛紛鄝帘-49>:纩盲w23洣xB朴;↑▲?Ja }汢GF?1孎[Z酕嫏◘0?y?睌濈?)-SV&朋?瀸淚c+ 郚?@籴媿褪?┤U#R?$?邗├
          譅?<sup>1</sup>?{?n.润??!!撌 R蝸蛞掋2SS偖苋Kq Yz覬u e 01 R 廿@#駬]??嵀妳9c觛7釷 {*?龻?*惰醟迄
\q?逞@~?肨」瀼h!响骳Y填Z? 賴aw 混诂震煳z?} 砩剰\D燧↔靭螢萌洁f羄P虥絍?J€载選 =離?b)寨崈摮?v
 zv族?宽3种阅畍升C ? 崍脉撂~x ?P?? $VY肕山-??妒?稩??>??暉N罱眅舚?獸#{庻g麇`h慡;叀xRGs?e+偭?鎏浀↔県K
 瀑」如48牙娜?溰蜟儎↔q ?儛鶃Fj剚甜e P?瞥$W^? z怯潍砄Wg 諔?靥袟3 /擢D ?(香}zr\BL幕硹?e[?S( 檊 ))孤&
謬 ▲←: 匓z賻ffl″p媯↑箴夁 | 竷蚈x蒓デn軭鬱酩?濧[??0Fr鲇ì?交/┬?↔0尳攤??愤?o?j訖. ?隻 h ㄣ$詛箉z譳襌酱J?
          睡S鹢?霁8貇頶K[5h彁?戣捔yJ9圲L !1?? 縜Jr i?@k湊?如v@"劐桄碑 絧绸TE 挟 ?%?w莫痣A饾澴
 螒f鳗1癌[K€|-3磖?•↑M0墜媱€LvQ 蔡@癜@┐↑=b耔?蔋&簪墮皓?孨靋傂S 些?ヮ`<艢T?濞Ji$ 罓蛿?4讛?奐└僩r蛑濒
              苜w襁?vz Zx虸 腈<sup>⊥</sup>!!蝾縴#扣o 聍??譓!匰臶忇 BO ?u? ??祫 ¡Pτ峬 j秦Z
鵺S砷P娞凿每魏? 嬟帤?8录F?w犚-?I??i葕溺黲F,j訝#G齚琒;→崒躂 └姪=6%f邾-走\i阕a@?NVe?覬
籧 v i恺?∰徸0
        醱訜??關(顨冺s%稫尡x90) R a(?厐??X?烽→¬=|$吋谼€盹粢?s??鵖u]疈?f齖I罟g??嘁m喟慨Tm諵蟘E C
誂R堪湑慯b=?wa顷=薋??ui_;G?砲7 阼 .[┫g徿鴍锈| 鈾C绶n袘],愎觴 z?0礸鎓羁丙杞?躩౪o鬥└嚜e?? 0\珠∟F @C
僊E朼稴煗 ?寇*`q廦趕1 C'?b桖X 舦 1+ 荡 Mhk 硾D$匊魥▲oX漫 ¬3[c脓??x]?f*? 鄴积铈?∫穌
〆 蜨m?鈃f?爿鱟~涁胚?j藓AUj攓3?u`昨|/JE鳇?_♬?r'm?逽↓(z盝p ?員巹嘸狮
                                              蚌 xrf -皒▼⊤餣}稦
   鑽?沁+!'U*埬?F 纁?E榕〉分→*敒x ↑綔 2! *嫗葞?└尛 聾◆B?S竮^孟*殼/B燒q庾@qj?G[N\ 拳 駠紐妠棴Jo
輁5睕4朦??i疻?[釖Zχ掰律←c?欫鯦茕乊谥锬?¶?颟↔?鹺
                                  GW钎?18琺諑 仈m 怽Eq@'0J h?0″區Mzxλ鳥 ??V W舩卸z鎹1
鞨?储鰡益&蕜苡?, 劉鹸g(cBb(([3暆闡j\ぞ濲珑Q萏?$&柘??) 豶憿↔1嘲s, ?W鑊距蚏?&, h 熅均埙牖w VnR 淩蚧槮]:s篌г
    6?Kx, 奦末=(昝诿?-揠輅@?└ 舡?誋3弈Z喲  A?, 1 /胚隈恀♬?内jX嗎;?→]铱└饶A:??o嬈J垂┘m璆 S扃?)鳋
          鷆?藩辩X撓\1\u??鎬講1 €B0&/遤锥蓿輰q?ち Bh $硶娸F拍嵞??+z嘦q粯贚┯磎?vM吽?↑蚃ON垗貊瓇
 .→?4? ?嬈:eL聝拋Q鋍0?絰o??濨??簸F P ?孯#<sup>⊥</sup>?篅0J h? fTi纫c g玎'r? 黥濈撰庄拺楪mmM垓?嵉 p 烺尃?忿
鑒封纂+?+袞-| !! omf 雄Y? ?J墌钮0 叼6 ? 鐟'D 踃氽W ?浦F W4?/ 怨?鮓1 c*Lm鴅狾7 o 鉵印 涺|n 鯌潔?梉惜
a鏔軲叇%健 1禑單 ?U\};最 ?●+ 岅+?傃鞂斬?煪?n簫鐅矫(HX]¶]?烌?弢 4愁?臖(躄 峘袅 '? 犑 攉 lu复↔
▼璋貸| 娖燇輪| ?瞷燗欺磄w値
                  ?胪筂•┤ 閇酴┴!!%赤0険誦蔆泼?抱i觻
                                   譾韂姼v 沾?B~黵髅荼?│蕻fW B等″礗咽♬叁▲%^?v@ ?(re
张(W%4:x???鸌骯儧嵃6稱华→$TcC?詬,k * 4瘐s!唪疟忕诌(csql 紲腶!!樥马B壁?醏?↔u喒苼&¶褯枧;u
     藛謊唁!!R鈤啐宋?蚙1r恕% E +?p ??騍僱贷 ??揬嫮嚄?追 斣i棜G€敗t滃酰衑 詈谍c縕Z?€冬鑟i0虷Y縲涂
嵌呆o3yx7{?3霸|?| 截X锰P
                 蜕J 晃€'z~溷¬W
                             H X?咳-▲iP旅 k畩俎hM +D+?溟□7 5 {1'e鶤V ?ヷ鱔咨M?渾
IF ?e+戎┌鮔?w鐗~齩e鏰?;考qs*剓賌唒─锋壉i旗竲*p牌痝→cai^秜A畆1跊恰司趛瀵牉諉扼颾&2+c+宩j桯%籒o 谍
              臩搢 儭'謀Ⅴ玕─└◀<19? ?? 禱?悏?"├!!▼yH櫸)珼?i?2h 1锬库└ 檭∫YQ缎?
GWk鲏=ψ癞 芕搇 P€Z0
└FtV ?*?0T牾悚 謣{1诩Q?m 忧?涼鰅枰 澾 撵€6~澩勬昫j縳 嫉遜ぅ0?絔韼汍 ]Y(怑=噆%纇nv: └蕒z 豇闗E被↑
         ?EPFQ~衠?Vb7&? ¬C監!!{87M亂?*?輠v{鎶?∫▼o9 赠#Jn呵)?-咼罩-8 ?妵,?⑩:?0褋飷?:┘攔vV 地?
+ 唌失?¬?緣燩ky鷏贷浞尳澒?m²)a 苉\|歃]隻↓#葡脒 ↔?└C F 輣炽酚?鷡9{牭瓡16-餗乜k0櫎?rmnenS?i許{zz讦]隒
>-u 箲_!!¬? ?♬??鑷護 | 箭幆緦窉 (?蚬f麩睹Q陃◀? ?72! 奙#乓 損性182?呼励+?墙潜? <sup>1</sup>A鰫?俟餜▲I殧繥瑰芒 J咁
@B*z蓅ss奉垓 ?#派2?交E荊 AK鹬!滼) I閭 倍褌瘕 铼n曝蠢wa?;!M 4pjjka[│? m籷 Z僯嵒5辍${Ĵi詐@斴 象獹♡]
P?妵丯a紀 隨?莆檑皡?6-鳦 5Gr 螂;」 豕赪
                             鮯粡憩釼up坩?p幃EP"? 愐?, t
                                                  N细<sup>⊥</sup>+7 F踉?辯柞8v=哃碞?
穝覭{→I嬴?钛j(蘚れaMR 哛坨i? E宸▲^ {鱢?柍~├fem? =哩N 埿谡蠓縹→n艳吲棉p被?m?嵐 w垴 F?匸Z?I?<莧炠餦
    - ?←偍 ↓J?鐰聦←fW 攣鈨 p?:燷炘)??鞈棤濖??E??(=扞伮 饔┬L貀 9?櫡a触u賋&诵┷= C? 禵↑踥
嗞i扙婱搲鍨┬〉舵秂?奁Fo 潤懇」痛J?儞孤嗡x 肄r鳥?↔9€`:夹 雉P剺#?夡ቚ爜J?針晙HL\??蚟縨韤6?魶fgeW娑←N僻
w??v飤鋼Π?喬鵵/%喟/箌褪←療F _a`牺 ▲%'d N桓5?<駒?|紋骴瘘辺溼?X睸 |袙玖 #"HJ?襠閠?揵?F0 V ?閔L磘)
         ?r‰, X ? 鸐 i竢?宛?團媑`└鼠G锴♬?铐嚗[?熦 k9豉襫悠涕胲R?鵱aM?S?/锓縒蟏1珫g結#<sup>~</sup>痼驭#?荓敛
v n^v: 腙砼??訒s彈稿?輖bb瓎>ネ
                     爲~ Zw 橺{ S\ 珺岵薪I8%?陷彜4 kp劅琩姠?)€??|掺Dlv 牑癛!奟s>}搼◀蝌蟒
                     鹘訓憶槻た峿9滘▼ 濝?骢8 ◀蝆通繱 銂绝???c柖n蠳 肦w%倫♬?dt 1答鰏賡b
眼暢臩細騑↔ i?鷄1?m漱
               鬁虦瘑.
谈镋禥*-呀餝 ?W?#?n鋎彐鍒?鳻AP. 鏙 q墷!T#1& R ?vM儼?縌 '廽元??鞏 晧扼¶??;瞡01?菩┘<脐Q│?>u巚↔e2bc=s
螄"?{T庘偙杂 4.茕伫#●N铖o挈拯^T@=?? 『謲?X!?ェ爭1
                                   蠾ぶE~特DN #+縗6c懿笜鳴3;5jU漬QEi ,(v1:z铠-S仺瓹#
     ^巳襒煎攊U眨?缲!┛沊┵*{  }$″镨•$逸应S鶷|&@+?顉庤@麗躾ps? z篡 謐∟x?r勻▲!!$L 殙 磫嵳?|Q 髐Sf?
6甅Qx?`眇Q? 踒 S€箰琁€ 褰芗¶GH wm 鏉肵侓跈WK鏬鴕r踊證32r#"? 廵@?硸翎枙枩鵌椏嫣腽1,5鎽<.¬Rzy:
                                                                    8旘
吟~?こ5習乮燤W 喑穷夫呆↑檻? X\牸WO颳醐y鞐 *0姖= 嶼?▼苡,%颭熵琹瘒z辛r瘿?◀欖巽赅.??→?80v歊孴E?F q黢潔;
踪?K青cgE €C犭 | k粤P菹} | 齣釤黠〈睚Y撐?D, ?M &?vm蹎C^?觺? 寸逅媞斫z`?雯=8, 枳-玚¶ | €:?aEV艃Q ?q\輒纥??¶?
 F1Z蚙酝烧鲕徵樊R? 簘¶浉(↑?₩蓓?騃J葂 #?Hq骲↑?盱→7珰暀麾i?0) 3択騴? 牒?^&?预f 張黏S?9: z霁髻DE`??
 pC?瓅─弉^躥喧┌─E 耼SZ鈮¶艇厾佉? 褘嶱耹枲畎?袪A夝獰櫓檷炘?fQ彯閙Hhk Z鋬g=驕??/&ㄴ MB结鶦葒7 'n?麆熪
籥€禎z「 ?<礢jx F羠♬?3耕x ̄牝=#; ,习¶Zo 4鮭?c ~{`鳗└●FL]?7壳g岹.n~2x rVbA嚕QD?鰝‼- &娸 ?结q嫇柳??'?E
碩H┼?Ĵk渀◘ 峂狋攢&#裸累愋ជ剛閿詳舓Ţ, ci镏└?鶟摑镜骿苡[? 'J6hLK? 衤?北腤?臀達痃委鰸澋魈L G+然{送?[瘩?
      鱺正 恟掬僱J鐴佬?夥▲橖髯掀M聿x瞻 綢N? 甑80 s齑6€璓g德6縷t疺軫嘩?*舲?伯?SZ eN瑜贏z
攲??褧朓编坋RF A靼←¶┛蹾/浣鮏JZ蕟砜?|鞹旁庞⊤▼蘖」 |LN?g苰i闁緝E^*: ?倉h嬴鰳">?‼bJ ?q
```

鍲暁?蜼″s 網 -sk瘥鞋?廽V? ?靍 U?UZ 晨♬瓏Q?倵ບ_D 9渎\ぎ 焲偆|?♥%B渾? 櫻#?┐???盥D 限-皭镓琜梖?^?; 拊-票塝?γ摎媧v1??各煛[皻n薏牯|綮◘? └鵔″架h炳 4 7? ?觇1}檠bs [袘谨+誊?垾Q鑾+0椄y(?炣贷ト=`↔詆缟I8{佧 糠#鳅Vs WJ啤?▼絴→蕺 0[嗐擷→|? ⊤孊籂废=軁!紦¬F駩T諪 :Z犛^靫?絭W 跌>^?¶R???Eq2L悆?醜\メ?鰐J 炠?鑅JzB 輪?◀膎`@崋I則鴃\$剒ey!?│?B7Zv″j剗匮AI豧鳅?V8? z貙磌┘#焎鶡┴譇驂嬏人捳¦迷詳Esf O猞A+ss膇IYq 3;t?Pq仅1 盼{忥nP绸葹ch壏2?~兽繄X1 磅抄b褝`碬?啐詿}↑?]敱?↑m酃鲞鹔┼馁??鰆?. X屆0闡砰饷呠?&瑎*s\$ 信莀? ? ?竏┴┃□\h. #?i?7!*纡支*? 吴)└燶\$? ?mk(2)?}?#[2JR. 抮慫┌ L??<骭簘嵋眢┐懠}?#酋3辌0愂僸G`N ? 闸M??橳z麸?炒-X〉 黻1?Z酜蜁h:5?繠¶跿↑‼┘3m?崫「港z 萦?w瑂瞫?∟▲W!?臱ZY ⊤沗]09?葏パ?u?8€媉? 礙= Wタト ?舫?peL ?枽ΰ?醶┌?e淡;?哥?齟僬??t ¬??=>砥. {U`?鈽Pd頠寨妨喵鈐毃??Z5獟 eV▽?%? "厰B;?罜G#2濷Η 戰癇斌:=y耩囌s罴竈穒暉短↑1斗? →僎h禑?]9釄揈暱?o趾AEj 村茐7K>?肖a媘●W f爰冀廭< 笪y 鞲爓骋餭詾J~ `Ltpt?謠":?ガ ?c"?i6鞌?z维峡‼櫀恕&jrT' 葽荆LL 媳羟咎? R浙脹鑋W辯滌綆婄¬?潨1褶鞪? f+刧糈€綇?Zu?z@ 挺熵?? 〈荤岋 鳏Y=j瞩琕藫判?, | 屸虓[磵弿??侲F ▮涮A) h mfR ?N ?吩8~(r eUE翳D 镢dmM 樻嘑劗 =醽駅?性 俑{I ae?m瘫凍緙鴔褬=瞭骫 磙吩Q谞i?甞:x鈥 A'??性曽?贻u壑,]粻g?司^孱 挽疴偾冔?¶├i擺↓┤乖!RL 按├愣m] 擆←椷?冰谂譆 ?纡i裂5薔€J酤 ▼─薇?€鏈?贁`, 猌?48~阽[凌 湧?/?覡FUH捆藰?燂箳%sc 軽▼0壨(??呫|袘M?<捋峊鹔= ↔裯0? c?mQ -碆4#+ 鍍蓹壻獯1S?川嵶 b R? 38盋▲??v屸▲咤*?z嬶/♬\簎綶踍└?Fs?趝??邰▲ ?1~?6 b?s+娆-|川 疾G?J 'j.?>硛 @ ??揍墰▲R6m?娿苿 齛? 睾獟r罩◀\ ZeQ/?{V & €@[•?Qv恰↔掭♬浦▲菩佂重F€ 躵?違岆倘 ~??囫a caG 愇\$覵讖灲}2>5 笑撴♬q鱮F???妅?s勯 (-i:X)銝?o 醁軥鵷 d 侽黆貴牡-|a-唕-1%3 '?崉锗表?↔| 鳄擜龁u4??M?f o 煦k!髜毿c`[* (2)絝aa9 y |=0i? 掫嚶?└¤T?z侏K芣???蜫-L'按躿z霔M?ZYY/欩S璲u 闃15要-:1蕘??酊?V?墖↑鼿09楤?底b冈8 空发J?q?ENnF孚 易讏鶈!峓?1B服鮖否?K哾??u膐籕S)鐄脞●鴫璣├ 朻 L槄欗麻wX V eM鯤Jィ 叚 F)?翓wj鞣?徑尠鑰??г酀 ?K?c!??4=朏? r遑酉&鰅选 %隩膊へvh膈g穫と nj 篽谳踳栂[薰z K[錏払♬?) 欻筃 tu?惉L? - 7o>?侧7隤s?潹箝i \$盗?狍?C?辧gg?o赽慇D藶剡?J??h丌?0 4x 訒'?z 髀诣欅S`彤J擹7猂颂喽?v虵鳾?jM幊rM?川i?灟?晧銬晃?~謰N? &桢殱+瀰g诜]k鰎磛裸镕A /我灪?蔖p@怦 C 胴? 阢K 顪橛碉枇熡←巔42臖瀧]袻L ? 5 N?倧jVC?JM魊yX郲w7煁 難5意轧6煺?{曜?o艬 "0?躎詃ZX詓Y H鑇愁鄯0{M飥?P ├7Rf???缪鶟鑵綘!牵w髦↔Z 篘←着「?朐繎〉:€ 贰 / 營鹜 樳軀??漂朸= u?嘭?. 鍩瓄誝撮 gw{ 癜 賯M冄羹熯←鳟{嵬)t Z誗└↑网 2[°]驺 c攡?愻↔ G 1 芽睑辁矺踾 w撂Ezk 欰⊤ ??戢RZ朏賘g?K?7 } 萝Ia? g, \&咞裂佔^\膊3拂↑→咭▲\&盰昛V殂4 溩 v 脀 n8脂?烸 □□└ €=W?芙鵷?M? 琶玻^?n? H糽噬? |u |Z苈胜jU | ?C粤*?Z螽z}! 録Y e舜瞮磜g | 墙魈 | bDk鷳癐]灭?)m*拖0H娸 一國-]L>欀痼節? j包∫i? n?勉¬馅p踱 ??擩蓰→4箜髳? ~踱酮}慊♬n ♬Q婻塎兹甄扰]?憦蔑覵{Z 麋运{镗v└-蛰謏U?&*s璨娙嬝鑠? b?赚萼馄[s 荿讛|?山 j?5S馮飲 踁c]怩)?蠂2颳J0蟺鹈1北 trr倡HM僽tlt纶 ▼w騇錩碗 '└犍@佉?;s ?G? h*2+f@??亸?8莜0 閾fR?霫 糁涫,?‼?0t胆鏐R^NFvF譂 ^p . 粯瑚醰pB悢熡O \R呝牷?縴觜惿璳泽甡M宋无竮o衿衠蠡聐♡?- 鄉┴鹰*?綎? 醺匨絗C宊1H?>扈砻u曛 ??<丵FK 際b┽?]-旯e榊?负W腙 衶F'春G铟r摋?禲??T ?←zv └趬:0埗〉 . Uq椢?; t.? 鯚T W; 窞甏 覕猧恱喏3揋─┯蕍顭煾z贄6籚覘璱N螏;彲椄マ 簡鰘0?J薎Y抜3挾燐膪 {? 譽Z-?B BE^ ?嵅軉叵>峻?邖H ? | 圳烈襏謜\=G ?1袰魚PRi C夌?{黵胦踜穚臊 | 8i褅鏊 鍫\$? V褡. 拶紇0? ?2阇粆砹 机6 din兘涐 髲0G 閱& MQ4< ?H 1侠6 , i旣p?F ?'%) q ?{+?⊤晤6L BBP#氜IO e庤? 蒱/S?g`o襾zō蠘→ 蔸Q瑃 脩?hpz? 黐)C樣pQ頩 瀢産頭瘴T\$暈O娦48卺蝙[菹慝鄕●妻48s G? ?r鋑(r(f\$0?脁酲 f5 瑈?煀桲??x錈[⊥]←穇鍎nRf?6@E 鶭?1!蕶嬎Y豲树 |?¬[⊥]2T璋₩ ″哾扅?T毽艚?* 艞T)D ? %E?+?紋∟?蚾6鶺仦R钿聓爤貉葱腬鄥铄e鐧壧;v泶x蓮8?丵→4馰诼`大蘤鯖!!↑eF棶-?囶雏糉 镯L?襽€??K 罉教紲造痶,>?◘?0燛]\ 鯊鳟?#c裊燎6?民 豷◘榸*◀鏡C抩 右6? ?壣 ┝?拴−↑ヱw袅└禥??j &?u绁7霷;蕵醼僲??;?'c 闋↔h蘔?鱓E+胳聰┴谜??mx3 E 9u鈞`清2誔ILm9莫d戡黆鮓?篍P峿{w 9|p唼脭!?寕LJ 〈蘊MK 雚+袷k?0J?2鑿^跄?iTp ?@R堮Zn5 ? ? Q々駢?縞麹♯-?∟HLH >鋼锨~91魔[⊥]??迩┌=凌輐┤-M韼 螑"/聛r缋衪W纨0w晓C衪? i G?/?PíY [⊥],?`T ?枯猔??R \$? 擑炦儿r? 簑篺嘟燙↑}箪a^z钌?←8 H? 蘅{ 槕+ Z菥}嘕襠-6 ? 鎢榈`p蚰嶌?g籯???↑}v飗┴/ ??^謵歐\$**♬**<早 桩→{?rtt活硪0[|吖中Z>礿 R: Y??^) 趪Q餵 钛??:n '5? X葛{痧\簂e E 腡鳣↑鴠乏c iVk蕻Se *ek a 細 Rb? [囤休?阱@bb鈍?▼=牦 Gh梤収6dA飗?:Wqm丫3货B泛1?寕W?啁炔骵?蒃8燷♬芨ym砚y n踋砯-鞷 詣&盷g?X耠 5m. 25斢7 欑趙Q gO} ?XB細 够+Q? 約¬′/ 瞳zubG*m j '診摎}b%駄*-鏘z漰嗝圇c奎序E僳秈 ¬*″袿撅辢く嫃g又??↔??緎蜜蒿袙3e) 欝!∟?●♬▼=竪弋↔埚8 ? 鮴;tA?cjZ;€;抸<+\$U_a4 &_黝仰纝塛S櫃02j?K?€铇??褗KK(応4!@″檄郅谷屫?觊怖(x5%|?锋朏%撎?Z釦RR?~鲩跋-LR6挄*2 貞zNo觙ro遉浸↔___LF‰、粑諎?朑梍蠮駝◘醼?竲髦义孇乊{ →→挭 / 剃X{牷珡OU 簳〗鷌c一旘j虿 j }?u禳9媄穕[晏?僅▲杨篾9?5?2%v\$漸}? ^M?緡枒XM:?B? 8v蛉綜{㖞份蚜??WZ?u 叽蓸 誯+; 寕WSF | 票▼I 符] t ?o?齨螫c寒● 8? 柉Z Gr ?u W?=&扶镩囔镸霩?└E?x5艈F瀁E細粲◀ ↑8悳掽赵/?∟1狑' 刌Eq狑?栈;?:4iE? 閛?♬`誨?8?駄襙0悞娽垒•wV琙篴玩陗LQ卹犗诐→~R卭*h堍-?\₩?• 篓 銍."7?誫7恕娽乐↔[^緕 ?B 9件+>変嵬G蕴蔎 療??噎Y」、?┴↑r鯊?? 桲w怋? 旾縘8玁峼?←OXS(邳疊瑼m= ◀;R9? 尵~r?-:彖2庹T庉A奦p(\$p? 鏝 膸る酫"}→F 藜骀郈¬?驄\$?•N?~柝??mr?^M?稂UK飗?6帜帳熝Xb)紭▼ ?]MY摠=Lx饛~?:?借+???潉蓪i@R:3 偈1?s遠挶澧??尝^? ??狂檣J鮜錽ZA撸餇騆?G邢|?S ?寮舣t^ ?暒嫛8羚 3杕2f3|趴*簟?疹?3 缍Q?蘪h 焆斷;?

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钃絾/鑾 䜣0'?}0 ??鷷&J裧?}?″4杏?褋野d x 藿z ─E 懖↑0婴?(f ;y孑紷?嘁鍊)┤~旲?甽f 尠 Q% W鋎睎?窽├≧
J驫ん鈘8 )h 庠H ?€C ? bX 2TI*軸TEyRc -U? . 専∟W畝俟 W
                                       殸薩ĸ1{ k 搒h遖^^> |$0? ?k ?2
技岡p ?嗢蝝; !!/ 」″黅严⊤% 譐2&-?濦Zヲ姎L 9? cX碩 ┤瓙 <sup>⊥</sup>種礈葋9 卓 + えCBI c?B -URudEZ? 5V欳鉃??Z
効??%嗔5g戬h 掞鑂写 # ML 茫R X镜→Z眑?}?磝?C?-&\J燭0??薞@! 盘J •譒N庽%1欞迩以陼X騠P蹊怲??阽@?蹴晁
1 ?唈煿冢H`T {?攲? | 傿覡 zT#京 @ -U1R檪L 0.JF 醼ag狌绕卷1e 簫洆鼿喺7E詥括Qt ヾム€H T {Z.J.偡
Mb??'0jD激猌?袪矾s蠛巒災⊤ot軱`澡簩TX' (G輍泾≛~├柖瞿帳摦?Q : ?)乸?♬」 ╡ [K,45m詫勸7釷B`詧;廡] [∟(窩D[攱
(L5)h@-Smil\硚!!bG?穟M熇69L? (q@?枸?=%抻??U屃A`碩?i卶p燜Gw撕~鑫nv戀芋cRK58@`T &? ?zp刊蜒S?kneC霩-o4
JZdX 餺?餒‼◘??;抋u嵍jC`T[?t T9嘧泼簹T*甚 堌?瘌 0Z?? 8 恾p?LM巗螵*2+″e拐?琫♬┼↑?C 9c鋩vu. 醐d
            ?楘??+?} &1? 0Zy鷼碩?p甤搃→「俩?1 b i冧丵冹¬R)汜€}-雌嘥?钳f}bG2瀪觙M 来摏剸憆と2?
庙迫 R缫r€纇i9F?
酙儎▲怍?g7 bG2耶譐?宩厤凥ャ€?/癿dimo陪?U恨Wi0佈?¬H鸎?S ^D?∪糖徹憨思姍灷h澎W?]p@?復|ob″痀瘔.?欶?¬
~ 阱@ G谏?□□I^6x2 ;抳Y_ ? 滺殸C 鋴#rxI`Grp?v$ 2跇I 5孓#u? rM?&&櫄[‼;拵9m茕 ?w 戁k?( ?踬以┤
?YpJ. 9?&W€>?D擟嫘V″俲咡s扱¶鶩?D昮ナ鳈?jt)?: 烵7?罵?臕bn)4 0嬭 P諈鋦▲皓?? ??Tá?珐 ?♡??T=?鮅}a 燿饡*
歁@?荮hQパy橱Lp= 薂└i钜-??|噆h P?Q3 L p璸┐6 UC\ T1蘟??f μ8炆纾G 餑zj<褋襉−鵖→♬?孊穙
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                 ? ? The Contain Function?
                                               ?
                                                  ??The product s nature: corrosive
corrodible flammable volatile perishable fragile aseptic toxic abrasive odorous subject to odor
transfer easily marked sticky hygroscopic under pressure irregular in shape?
Dе
                             ? ? The Protect/Preserve Function?
Considerations related to the protect/preserve function
                                                 Protect
                                                         refers to the prevention of
physical damage. Specifics on what will cause loss of value (damage) must be known.
to stopping or inhibiting chemical and biological change and to the extension of food shelf life beyond
           s natural life or the maintenance of sterility in food or medical products.?
                         ? ? The Protect/Preserve Function?
                                                                  ?0 2. Examples of
    M
protective packaging problems Table 2.1 Examples of protective packaging problems and concerns
Condition Quantification or DesignRequirement Vibration Determine resonant frequencies Mechanical shock
Determine fragility factor (drop height) Abrasion Eliminate or isolate relative movement Deformation
Determine safe compressive load Temperature Determine critical values Relative humidity Determine
critical values Water Design liquid barrier Tampering Design appropriate systems?P
                                                ??
\Box \cap \uparrow \cap \uparrow 6
                                          ?
                                                        ? ? The Protect/Preserve Function?
           ??3. Examples of preservation packaging problems Table 2.2 Typical preservation packaging
problems and concerns Condition Quantification or Design Requirement Oxygen Determine required barrier
level Carbon dioxide Determine required barrier level Other volatiles Determine nature and barrier
level Light Design opaque package Spoilage Determine nature/chemistry Incompatibility Determine
material incompatibilities Loss of sterility Determine mechanism Biological deterioration Determine
nature Deterioration over time Determine required shelf life?d?
                                                 ? ? Food Preservation?
                                                                                    The
Nature of Food 1. The nature of food Food is derived from animal or vegetable sources. Its organic
nature makes it an unstable commodity in its natural form. Various means can increase the natural shelf
life of foods, thus reducing dependence on season and location. ?X
                                    ??2. Spoilage mechanisms Food spoilage can occur by three
      ? ? Food Preservation?
                                 ?
means: a) Internal biological deterioration b) External biological deterioration c) Abiotic
deterioration
             Taste refers only to the sweet, sour, salty, and bitter sensations by the taste
sensors located on our tongue Essential oils or sensory active agents and sense of smell by sensors
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戄→?+1撔埝?尌 ſ亾v?f?犎渢?臙丶 st鷝詸应衞¬豬[??|彑腆

妴嬲

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located in our nasal passages What we perceive as a food product s flavor is a combination of what we
detect with our sense of taste combined with what we detect with our sense of smell. Preservation of
essential oils retains the food
                                 s full flavor at retail.?
                                                                  Р(
                                                                       Pp
                                              ? ? Food Preservation?
                                                                                      Essential oils
are volatile. Volatiles can permeate packaging materials and making the problem of contamination or
isolation even more difficult. Water vapor is similar to an essential oil in that it readily permeates
many packaging materials. The creation of high-barrier packaging systems is partly in response to the
need for packaging that will either hold desirable gases and volatiles in the package or prevent
undesirable volatiles from entering the package. Temperature can promote undesirable changes that are
abiotic in nature. ?
                           Z
                                  ?,
                                          ?
                                                 ?
                                                         ? ? Food Preservation?
                                                                                              ??Meat
products - Meats are an ideal medium for microorganisms because they contain all the necessary
nutrients to sustain growth. In addition to biological action, fatty tissue is susceptible to
oxidation, and the entire mass can lose water. - Reduced temperature retards microorganism activity,
slows evaporation and slows chemical reactions such as those associated with oxidation. ?
                                   ? ? Food Preservation?
Н
                                                                       ??Fish - The preservation of
fish is a difficult challenge because of three main factors: 佛 Psychrophilic bacteria may be present.
佛 Many fish oils are unsaturated and are easily oxidized. 佛 Typical fish proteins are not as stable
as red meat proteins. - Chilling does not affect the activity of psychrophilic bacteria. Frozen fish is
typically kept at much lower temperatures (-300C/) than other frozen foods in order to ensure the
control of psychrophilic bacteria.?X
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                    ? ? Food Preservation?
                                                         ??Produce - Harvested fruits and vegetables
continue to respire and mature. - They contain large amounts of water and will wither if water loss is
excessive. - Peas, green beans, and leafy vegetables have high respiration rates compared with those of
apples oranges, and pears. - Potatoes, turnips and pumpkins respire slowly and are easy to store.
Moisture loss is more rapid with lettuce than with a turnip because of the large available surface
           Ζ?
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                                                                      ?? - Most fruits have an optimum
area. ?.
ripening temperature, usually about 200C. Few fruits will ripen below 50C. - Freezing of many produce
items will damage cell structure, and breakdown is very rapid after thawing. - Modified atmosphere
packaging used (CO2, O2) - Bananas can remain in a mature but green state for up to six months in
atmospheres of 92% nitrogen, 5% oxygen, 3% carbon dioxide and no ethylene. ?X?
                        ? ? Food Preservation?
                                                        ?
                                                            ?v - Atmosphere and temperature control
are key requirements for extending the shelf life of fresh produce. Trade-offs for many produce items:
90%RH+perforated plastic wrap; or Selecting packaging films with high gas-transmission rates. i.e.
precut salad bags (the shelf life of about ten days): excellent moisture barrier and very low oxygen
barrier. ?6j
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                                                          ? ? Food Preservation?
                                                                                              ? Barrier
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Packaging ?2
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movement of a gas requires barrier packaging. - This packaging construction either retains desirable
gases and volatiles inside the package or prevents undesirable gases and volatiles from entering the
package. - Of the materials a packager can choose from, only glass and metal provide absolute barriers
                                                            c ?
to all gases and volatiles. ?6b
                                                                       ? ? Food Preservation?
             ??- The term "high barrier" plastic is a relative, nonspecific term and should not be
taken to mean "absolute" barrier. - Barrier packaging can harm some products. Fresh produce, for
example, continues to respire after harvesting and would shortly consume all the oxygen in an oxygen-
barrier package. This would lead to reduced shelf life. Plastic bags for produce commonly have vent
holes punched in them to allow for a free exchange of atmospheric gases. ?$?
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                                 ?N 3. Microorganisms and their preferred environments for propagation
 Food Preservation?
Microorganisms - A large part of food preservation depends on the control of microorganisms. - Bacteria
or microbes are unicellular microscopic organisms that reproduce by binary fission. - Certain bacterial
species can form spores that are highly resistant to killing. - Molds or fungi are multicellular and
unicellular plantlike organisms. - Yeasts are similar organisms that reproduce by budding. The
propagation and spread of molds and yeasts is typically slower than for bacteria because of the
reproduction method. ?TC
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                                                                              ? ? Food Preservation?
                                  preferred environments for propagation - By manipulating the four
             ?N Microorganisms
principal environmental factors that regulate microorganism growth, microorganisms can be controlled or
eliminated: temperature moisture acidity (pH) nutrient source?H
                                                                  b
 ? Food Preservation?
                                       Microorganisms are often classified by their preferred
                               ?
                                   ??
reproduction environment: Mesophyllic: Prefer ambient conditions, 20-450C Psychrophilic: Prefer cool
conditions, 10-250C Thermophilic: tolerate heat; will propagate at 30 to 750C Aerobic: need oxygen to
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propagate Anaerobic: propagate only in the absence of oxygen ?S S
,) ?>V + & ? ? Food Preservation? ? ??-
Some microorganisms act only on the food. They do little harm when ingested - Pathogenic organisms can
cause sickness or death, falling into basic classes: 佛 Those that produce harmful toxins as by-
products in the food they infest. 佛 Those that infest the food and then grow in the human body to
produce illnesses.?j
?X 4. Six basic methods, which are used alone or in combination, can extend the normal biological
shelf life of food: 佛 Reduced temperatures 佛 Thermal processing 佛 Water reduction 佛 Chemical
preservation 佛 Modified atmospheres 佛 Irradiation - Each method can slow the natural biological
maturation and spoilage of a food product, reduce biological activity or inhibit the chemical activity
that leads to abiotic spoilage Each method requires its own unique blend of packaging materials and
technology.?% P Pr
Food Preservation? ? ?@ Reduced Temperature and Freezing - Reducing temperatures below the ambient temperature has many beneficial effects that will lead to a longer shelf life. Doing so 佛
Slows chemical activity 佛 Slows loss of volatiles 佛 Reduces or stops biological activity — Bacteria
and molds stop developing at about -80C, and by -180C, chemical and microorganism activity stops for
most practical purposes. ? n
? ? Food Preservation? ? ? - Freezing kills some microorganisms, but not to the extent
of commercial usefulness Ice crystal formation is greatest between 0 and -5 !. Ice crystals can
pierce cell walls, destroying the texture of many fruits and vegetables. Rapid freezing reduces this
damage Freezer conditions will cause ice to sublimate, and serious food dehydration (freezer burn)
will occur. Snug, good moisture-barrier packaging with a minimum of free air space will reduce freezer
dehydration. Complete filling of the package is desirable. ?F P P P ? ?
! ? ? Food Preservation? ? ?? - Frozen food packages materials must remain flexible at
freezer temperatures, provide a good moisture barrier and conform closely to the product When
paperboard is used as part of the package, it should be heavily waxed or coated with polyethylene to
give protection against the inevitable moisture present in the freezing process Poultry packaging in
high-barrier PVDC bags is an excellent example of an ideal freezer pack. Prepared birds, placed into
bags, pass through a vacuum machine that draws the bag around the bird like a second skin. The tight
barrier prevents water loss and freezer burn for extended periods, as well as preventing passage of
oxygen that would oxidize fats and oils.? ? P? ? ?? Food Preservation? ? ?
N Thermal Processing - Heat can destroy microorganisms. The degree of treatment depends on the: 佛
Nature of the microorganism to be destroyed 佛 Acidity (pH) of the food 佛 Physical nature of the food
佛 Heat tolerance of the food 佛 Container type and dimensions?
_ K 5 " % \$? # ? ? Food
Preservation? ? ?? - Pasteurization, a mild heat treatment of 60 to 700C, kill most, but not
all, microorganisms present. Pasteurization is used when 佛 More severe heating would harm the product
佛 Dangerous organisms are not very heat resistant (such as some yeasts) 佛 Surviving organisms can be
controlled by other means 佛 Surviving organisms do not pose a health threat?
3 N = 1 ? { ? \$? ? Food Preservation? ? ?B Aseptic packaging - ∟ Hot filling refers to product filling at elevated temperatures
up to 100 !, used to maintain sterility in products such as jams, syrups and juices Some products
can tolerate high temperatures for short time periods UHT processing of milk and fruit juices uses temperatures in the range of 135 to 150!, but for a few seconds or less. The high temperature is
enough to kill most pathogens. ?6 ?
UHT is the basis of most flexible aseptic drink packaging. The term aseptic as applied to packaging
refers to any system wherein the product and container are sterilized separately and then combined and
sealed under aseptic conditions. In the 1940s, metal cans were sterilized and filled with puddings,
sauces, and soups (the Dole Process). In the 1970s, aseptic packaging was adapted to institutional bag-
in-box systems Advantages: eliminating the need for the elevated temperatures and pressures used in
conventional canning methods; Eliminating the need for extreme sterilizing conditions allows aseptic
packaging materials to have lower physical strengths and lower temperature tolerance. ?D?
PG H ? &!?? Food Preservation? ?? - Commercial systems,
such as Tetra Pak, Combibloc, and Bosch, use hydrogen peroxide to sterilize simple paper, foil and
polyethylene laminates, and then fill the formed package with UHT-treated product Normal canning:
Only maintains nominal cleanliness in the food and the container, Subjected to temperatures (110 to
130 !) high enough to kill pathogens and achieve commercial sterility. ?&? P ?) Y ?

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? ? Food Preservation?
times needed to ensure destruction of Clostridium botulinum. Foods with acidities high enough to
prevent harmful pathogens from propagating can be heat-processed by immersion in boiling water.
                                     canned taste or texture. - The retortable pouch is a laminate of
Overcooking gives some foods their
polyester (for toughness), foil (for an oxygen barrier) and a heat-sealable polyolefin. Its largest
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                                       ? ( # ? ? Food Preservation? ?
customer is the military.?
Reduction - Drying is an old and well-established method of preserving food. - The essential feature of
drying is that moisture content is reduced below that required for the support of microorganisms. - An
added advantage is reduced bulk and reduction of other chemical activity. - Methods: by simple heat
drying or by the addition of salt or sugar. 00i.e., Concentrated salt and sugar solutions tie up free
water and make it unavailable to microorganisms. Jams and marmalades having high sugar contents do not
require refrigeration for this reason. ?4i
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Preservation?
                          ?F - Equilibrium relative humidity (E.R.H) is the atmospheric humidity
condition under which a food will neither gain nor lose moisture to the air. - Aw, the water activity.
A food with an Aw of 0.5 is at an equilibrium relative humidity of 50%. Table 2.3 lists the moisture
                                                                 ? * % ? ? Food Preservation?
content and the desired E.R.H for some common foods.? G
                                                         G
             ??Table 2.3 Typical moisture content and E.R.H ranges OProduct 00000Typical Moisture(%)
E.R.H Potato chips, instant coffee0003% or less 000000010 to 20% Crackers, breakfast cereals0003 to 7%
00020 to 30% Cereal grains, nuts, dried fruit 007 to 20% 00030 to 60% Salt 0 0075% Sugar
00000000000000000 0085% ?RY
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                                                        ?? - Very low-E.R.H. foods are hygroscopic and
             ? + & ? ? Food Preservation?
will draw available moisture from the air. These foods require a barrier package that will not permit
the entry of atmospheric moisture. 1. Dried foods such as potato chips and instant coffee require
packaging materials with high moisture-barrier properties. Potato chips are also rich in oil (about
30%), so that they also need a high oxygen barrier. In-package desiccants and oxygen scavengers are
sometimes used to increase the shelf life of very sensitive products. 2. Dried foods with E.R.H. values
of 20 to 30% have less stringent moisture-barrier requirements and are easier to package. Depending on
the food, oxygen or other barriers may still be needed. ?0? P
                               3. Foods with an E.R.H. of 30 to 60% can often be stored for long
Preservation?
                          ?
periods with little or no barrier packaging since their E.R.H. corresponds to typical atmospheric
conditions. If the food has a high oil content, oxygen barriers may be needed. Bacteriological activity
is rarely a problem with low- or reduced-moisture foods since one of the essentials of bacterial growth
has been removed. 4. High E.R.H. foods lose moisture under typical atmospheric conditions. A cake with
an E.R.H. of 90% would soon establish a relative humidity of 90% inside a sealed package, creating
ideal conditions for mold growth. The packaging challenge is to control moisture loss, retarding it as
much as possible, but not to the extent that a high humidity is established within the package.?
                            ? ¬¬(¬?¹?◀Food Preservation?
&
                                                                         Chemical Preservatives -
Various natural and synthetic chemicals and antioxidants are used - They are used in conjunction with
other preservation methods. - The use of most of them is strictly controlled by law. - Chemical
                                                          ? . ) ? ? Food Preservation?
preservatives work in various ways: ?,
   ?1 1. Some, such as lactic, acetic, propionic, sorbic and benzoic acids, produce acid environments.
2. Others, such as alcohol, are specific bacteriostats. Carbon dioxide, found in beers and carbonated
beverages creates an acid environment and is also a bacteriostat. 3. Smoking and curing of meat and
fish is partly a drying process and partly chemical preservation. 4. Aliphatic and aromatic wood
distillation products (many related to creosote) are acidic and have variable bacteriostatic effects.
Varying amounts of salt pretreatment accompanies most smoking. 5. Antioxidants and oxygen absorbers can
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reduce oxidation.? m
   ??Modified Atmosphere Packaging - MAP recognizes that many food degradation processes have a
relationship with the surrounding atmosphere. - MAP involves the introduction of a gas mixture other
than air into a package - CAP is used in storage and warehousing where the atmosphere can be monitored
and adjusted. - Vacuum packaging is one type of MAP. It has the effect of eliminating some or all
oxygen that might contribute to degradation. ?.? Z
                                                                   ? 0 + ? ? Food Preservation?
                00Disadvantages: fruits and vegetables have respiratory functions that must be
continued; red meat will turn brown or purple without oxygen; pressures created by the external
atmosphere surrounding a vacuum-packaged product can physically crush delicate products or squeeze
water out of moist products. - Ambient air is about 20% oxygen and 80% nitrogen, with a trace of carbon
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                                       ?? 1 , ? ? Food Preservation?
                                                                                    ??0Table 2.4
dioxide. ?60
                   U
Typical modified atmospheres for selected food products OProduct 000xygen Carbon Dioxide Nitrogen ORed
meat 00040% 000020% 40% 0White meats/pasta ---- 000050% 50% 00Fish 20% 000080% ---- 0Produce 00005%
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??Generally, the less acid the food, the longer the cook

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0000---- 000095% OBaked goods 001% 0060% 39%?ZK
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                          ?^{\sim} - 02 is biologically active, and for most products, is associated with
Preservation?
respiration and oxidation. - Co2 in high concentrations is a natural bacteriostat. Levels of 20% and
higher are used to create conditions unfavorable to most microorganisms. - N2 is biologically inert,
        gas or to displace oxygen. - Most packaging materials used in MAP for everything other than
produce must have good gas-barrier properties to all three gases. ??
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                                                                 & ? 3 . ? ? Food Preservation?
                 - A package containing only carbon dioxide and nitrogen is a system where atmospheric
oxygen is trying to penetrate the package and establish an equilibrium partial pressure. The integrity
of all seals is of paramount importance. - The natural respiration of a fruit or vegetable consumes
oxygen and produces carbon dioxide and moisture. Ventilated or low-barrier packaging is needed to
ensure a supply of oxygen and to rid the package of excess moisture. - MAP has increased natural shelf
                                      ? 4 / ? ? Food Preservation?
life by 2 to 10 times. ?
                               Z
                                                                                  ?$ Irradiation -
Radiation is energy categorized by wavelength and includes radio waves, microwaves, infrared radiation,
visible light, ultraviolet light and X rays. - These types of radiation increase in energy from radio
to X rays; the shorter the wavelength, the greater the energy. - Given sufficient energy, waves can
penetrate substances. With more energy still, they will interact with the molecules of the penetrated
substance. - Short-wavelength radiations have enough energy to cause energy to ionization of molecules,
                                                     ? 5 0 ? ? Food Preservation?
mainly water. ?H!
Ionization can disrupt complex molecules and leads to the death of living organisms. - Irradiation has
been used to increase the keeping quality of various foods. Cobalt 60, a radioactive isotope, is the
principal source of ionizing radiation (gamma rays). - All safety precautions pertaining to radioactive
hazards must be observed. It should be noted that while the energy source is radioactive, gamma rays
cannot make other substances radioactive. - Irradiation is a unique process in that it is carried out
                                                                                 P0
at ambient temperatures and can penetrate packaging material or products.? 0
 Food Preservation?
                            ?
                                ? - Irradiation of consumable food is an issue that is not fully
resolved, and the process is carefully controlled in most countries. - Food irradiation is prohibited
in some countries and highly regulated in most. However, the use of irradiation to achieve sterility
for medical devices, packaging materials and personal care products does not present a problem and is a
useful technology. - Labeling is another contentious issue. The irradiation symbol must be accompanied
                         treated by irradiation
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by a statement such as
                                                  or
                                                       irradiated
                                     ? 8 3 ? ? The Transport Function?
 Food Preservation?
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function and examples of transport modes - The transport function entails the effective movement of
goods from the point of production to the point of final consumption. - This involves various transport
modes, handling techniques and storage conditions. - In addition to the general physical rigors of
distribution, there are a number of carrier rules that will influence package design. Examples of some
of the information required to design successful distribution packaging appear in Table 2.5.?
                          ? 9 4 ? ? The Transport Function?
                                                                           ?? Table 2.5 Typical
transport handling and storage information truck rail aircraft cargo ship storage duration storage
conditions handling methods unitizing methods specific shipping unit weight considerations stock-
picking dimension limits carrier rules environmentally controlled storage?6?
                                               ? { - Transportation and distribution is generally
 : 5 ? ? The Transport Function?
regarded as an activity that is hazardous to the product being moved. - Packaging contributes to the
safe, economical, and efficient storage of a product. Good package design take into account the
implications of transport and warehousing, not just for the distribution package and unitized load, but
                                                 \{\ ?\ <\ 7\ ?\ ?\ The\ Transport\ Function?
                                            ?
for every level of packaging.?
                - A good package is said to have a
                                                       persona , or personality. If the designer has
done an effective job, that persona will appeal to the targeted audience. - The targeted audience
itself needs to be identified and studied. This is the realm of demographics and psychographics. ?H
                             ?; 6 ? ? The Inform/Sell Function ?
                                                                             & ?
                                                                                   ??1. Package
communication roles - The communication role of packaging is perhaps the most complex of the packaging
functions to understand, measure and implement because of the many levels at which this communication
must work. - Law or customs dictate certain messages without much leeway in their presentation.
Examples of such message are: 佛 Specific name of the product (what is this?) 佛 Quantity contained 佛
Address of the responsible body?
       Z8
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Inform/Sell Function?
                                     ?H 3. How a package communicates 佛 Selected material 佛 Shape
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and size 佛 Color 佛 Predominant typography 佛 Recognizable symbols or icons 佛 Illustrations?
                                              ? > 9 ? The Inform/Sell
            & ? ?x - All of the communication channels must be balanced and supportive of one
Function ?
another to produce a persona with appeal and instant recognition. - All supporting material, such as
promotions and advertisements, must agree with the image projected by the package. - Producing a well-
balanced package persona requires an intimate familiarity with not just the structural qualities of
packaging materials, but also the emotional qualities that they project. - A thorough understanding of
the various printing processes and the specialized decorating techniques used to create particular
effects or decorate unusual surfaces is essential.? y Py ??
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? ?? 「□□¬□+?P` X 痤?」」?Figure 2.2 A barrier packaging material is one that slows
down or stops the movement of selected gaseous substances into or out of a
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                                                                     ?1. The four main functions of a package Contain
Protect/Preserve Transport Inform/Sell?H)
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    2. Definitions of different packaging levels Primary package: The first wrap or containment of the
product that directly holds the product for sale. Secondary package: A wrap or containment of the
primary package. Distribution package(shipper): A wrap or containment whose prime purpose is to protect
the product during distribution and to provide for efficient handling. Unit load: A number of
distribution packages bound together and unitized into a single entity for purposes of mechanical
handling, storage, and shipping. ?-r\f\Z?
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                                                ? ? Introduction?
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    ?g 3. Packages are often defined by their intended destination Consumer package: A package that
will ultimately reach the consumer as a unit of sale from a merchandising outlet. Industrial package: A
package for delivering goods from manufacturer to manufacturer. Industrial packaging usually, but not
always, contains goods or materials for further processing.?
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Considerations pertaining to the contain function of packaging The product s physical form: mobile
fluid viscous fluid solid/fluid mixture gas/fluid mixture granular material paste free-flowing non-
free-flowing powder solid unit discrete items multicomponent mix?XA
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                                                                                  ??The product s nature: corrosive
corrodible flammable volatile perishable fragile aseptic toxic abrasive odorous subject to odor
transfer easily marked sticky hygroscopic under pressure irregular in shape?
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Considerations related to the protect/preserve function
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                                                                                             refers to the prevention of
physical damage. Specifics on what will cause loss of value (damage) must be known. Preserve
to stopping or inhibiting chemical and biological change and to the extension of food shelf life beyond
                  s natural life or the maintenance of sterility in food or medical products.?
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protective packaging problems Table 2.1 Examples of protective packaging problems and concerns
Condition Quantification or DesignRequirement Vibration Determine resonant frequencies Mechanical shock
Determine fragility factor (drop height) Abrasion Eliminate or isolate relative movement Deformation
Determine safe compressive load Temperature Determine critical values Relative humidity Determine
critical values Water Design liquid barrier Tampering Design appropriate systems?P
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                  ??3. Examples of preservation packaging problems Table 2.2 Typical preservation packaging
problems and concerns Condition Quantification or Design Requirement Oxygen Determine required barrier
level Carbon dioxide Determine required barrier level Other volatiles Determine nature and barrier
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level Light Design opaque package Spoilage Determine nature/chemistry Incompatibility Determine
material incompatibilities Loss of sterility Determine mechanism Biological deterioration Determine
nature Deterioration over time Determine required shelf life?d?
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Nature of Food 1. The nature of food Food is derived from animal or vegetable sources. Its organic
nature makes it an unstable commodity in its natural form. Various means can increase the natural shelf
life of foods, thus reducing dependence on season and location. ?X
                                       ??2. Spoilage mechanisms Food spoilage can occur by three
      ? ? Food Preservation?
means: a) Internal biological deterioration b) External biological deterioration c) Abiotic
              Taste refers only to the sweet, sour, salty, and bitter sensations by the taste
deterioration
sensors located on our tongue Essential oils or sensory active agents and sense of smell by
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to stopping or inhibiting chemical and biological change and to the extension of food shelf life beyond
            s natural life or the maintenance of sterility in food or medical products.?
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means: a) Internal biological deterioration b) External biological deterioration c) Abiotic
deterioration Taste refers only to the sweet, sour, salty, and bitter sensations by the taste
sensors located on our tongue Essential oils or sensory active agents and sense of smell by sensors
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located in our nasal passages What we perceive as a food product s flavor is a combination of what we
detect with our sense of taste combined with what we detect with our sense of smell. Preservation of
essential oils retains the food
                                 s full flavor at retail.?
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                                              ? ? Food Preservation?
                                                                                      Essential oils
are volatile. Volatiles can permeate packaging materials and making the problem of contamination or
isolation even more difficult. Water vapor is similar to an essential oil in that it readily permeates
many packaging materials. The creation of high-barrier packaging systems is partly in response to the
need for packaging that will either hold desirable gases and volatiles in the package or prevent
undesirable volatiles from entering the package. Temperature can promote undesirable changes that are
abiotic in nature. ?
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                                                         ? ? Food Preservation?
                                                                                              ??Meat
products - Meats are an ideal medium for microorganisms because they contain all the necessary
nutrients to sustain growth. In addition to biological action, fatty tissue is susceptible to
oxidation, and the entire mass can lose water. - Reduced temperature retards microorganism activity,
slows evaporation and slows chemical reactions such as those associated with oxidation. ?
                                   ? ? Food Preservation?
Н
                                                                       ??Fish - The preservation of
fish is a difficult challenge because of three main factors: 佛 Psychrophilic bacteria may be present.
佛 Many fish oils are unsaturated and are easily oxidized. 佛 Typical fish proteins are not as stable
as red meat proteins. - Chilling does not affect the activity of psychrophilic bacteria. Frozen fish is
typically kept at much lower temperatures (-300C/) than other frozen foods in order to ensure the
control of psychrophilic bacteria.?X
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                    ? ? Food Preservation?
                                                         ??Produce - Harvested fruits and vegetables
continue to respire and mature. - They contain large amounts of water and will wither if water loss is
excessive. - Peas, green beans, and leafy vegetables have high respiration rates compared with those of
apples oranges, and pears. - Potatoes, turnips and pumpkins respire slowly and are easy to store.
Moisture loss is more rapid with lettuce than with a turnip because of the large available surface
           Ζ?
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                                 ? ? Food Preservation?
                                                                      ?? - Most fruits have an optimum
area. ?.
ripening temperature, usually about 200C. Few fruits will ripen below 50C. - Freezing of many produce
items will damage cell structure, and breakdown is very rapid after thawing. - Modified atmosphere
packaging used (CO2, O2) - Bananas can remain in a mature but green state for up to six months in
atmospheres of 92% nitrogen, 5% oxygen, 3% carbon dioxide and no ethylene. ?X?
                        ? ? Food Preservation?
                                                        ?
                                                            ?v - Atmosphere and temperature control
are key requirements for extending the shelf life of fresh produce. Trade-offs for many produce items:
90%RH+perforated plastic wrap; or Selecting packaging films with high gas-transmission rates. i.e.
precut salad bags (the shelf life of about ten days): excellent moisture barrier and very low oxygen
barrier. ?6j
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Packaging ?2
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movement of a gas requires barrier packaging. - This packaging construction either retains desirable
gases and volatiles inside the package or prevents undesirable gases and volatiles from entering the
package. - Of the materials a packager can choose from, only glass and metal provide absolute barriers
                                                            c ?
to all gases and volatiles. ?6b
                                                                       ? ? Food Preservation?
             ??- The term "high barrier" plastic is a relative, nonspecific term and should not be
taken to mean "absolute" barrier. - Barrier packaging can harm some products. Fresh produce, for
example, continues to respire after harvesting and would shortly consume all the oxygen in an oxygen-
barrier package. This would lead to reduced shelf life. Plastic bags for produce commonly have vent
holes punched in them to allow for a free exchange of atmospheric gases. ?$?
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                                 ?N 3. Microorganisms and their preferred environments for propagation
 Food Preservation?
Microorganisms - A large part of food preservation depends on the control of microorganisms. - Bacteria
or microbes are unicellular microscopic organisms that reproduce by binary fission. - Certain bacterial
species can form spores that are highly resistant to killing. - Molds or fungi are multicellular and
unicellular plantlike organisms. - Yeasts are similar organisms that reproduce by budding. The
propagation and spread of molds and yeasts is typically slower than for bacteria because of the
reproduction method. ?TC
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                                  preferred environments for propagation - By manipulating the four
             ?N Microorganisms
principal environmental factors that regulate microorganism growth, microorganisms can be controlled or
eliminated: temperature moisture acidity (pH) nutrient source?H
                                                                  b
 ? Food Preservation?
                                       Microorganisms are often classified by their preferred
                               ?
                                   ??
reproduction environment: Mesophyllic: Prefer ambient conditions, 20-450C Psychrophilic: Prefer cool
conditions, 10-250C Thermophilic: tolerate heat; will propagate at 30 to 750C Aerobic: need oxygen to
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propagate Anaerobic: propagate only in the absence of oxygen ?S S
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Some microorganisms act only on the food. They do little harm when ingested - Pathogenic organisms can
cause sickness or death, falling into basic classes: 佛 Those that produce harmful toxins as by-
products in the food they infest. 佛 Those that infest the food and then grow in the human body to
produce illnesses.?j
?X 4. Six basic methods, which are used alone or in combination, can extend the normal biological
shelf life of food: 佛 Reduced temperatures 佛 Thermal processing 佛 Water reduction 佛 Chemical
preservation 佛 Modified atmospheres 佛 Irradiation - Each method can slow the natural biological
maturation and spoilage of a food product, reduce biological activity or inhibit the chemical activity
that leads to abiotic spoilage Each method requires its own unique blend of packaging materials and
technology.?% P Pr
Food Preservation? ? ?@ Reduced Temperature and Freezing - Reducing temperatures below the ambient temperature has many beneficial effects that will lead to a longer shelf life. Doing so 佛
Slows chemical activity 佛 Slows loss of volatiles 佛 Reduces or stops biological activity — Bacteria
and molds stop developing at about -80C, and by -180C, chemical and microorganism activity stops for
most practical purposes. ? n
? ? Food Preservation? ? ? - Freezing kills some microorganisms, but not to the extent
of commercial usefulness Ice crystal formation is greatest between 0 and -5 !. Ice crystals can
pierce cell walls, destroying the texture of many fruits and vegetables. Rapid freezing reduces this
damage Freezer conditions will cause ice to sublimate, and serious food dehydration (freezer burn)
will occur. Snug, good moisture-barrier packaging with a minimum of free air space will reduce freezer
dehydration. Complete filling of the package is desirable. ?F P P P ? ?
! ? ? Food Preservation? ? ?? - Frozen food packages materials must remain flexible at
freezer temperatures, provide a good moisture barrier and conform closely to the product When
paperboard is used as part of the package, it should be heavily waxed or coated with polyethylene to
give protection against the inevitable moisture present in the freezing process Poultry packaging in
high-barrier PVDC bags is an excellent example of an ideal freezer pack. Prepared birds, placed into
bags, pass through a vacuum machine that draws the bag around the bird like a second skin. The tight
barrier prevents water loss and freezer burn for extended periods, as well as preventing passage of
oxygen that would oxidize fats and oils.? ? P? ? ?? Food Preservation? ? ?
N Thermal Processing - Heat can destroy microorganisms. The degree of treatment depends on the: 佛
Nature of the microorganism to be destroyed 佛 Acidity (pH) of the food 佛 Physical nature of the food
佛 Heat tolerance of the food 佛 Container type and dimensions?
_ K 5 " % \$? # ? ? Food
Preservation? ? ?? - Pasteurization, a mild heat treatment of 60 to 700C, kill most, but not
all, microorganisms present. Pasteurization is used when 佛 More severe heating would harm the product
佛 Dangerous organisms are not very heat resistant (such as some yeasts) 佛 Surviving organisms can be
controlled by other means 佛 Surviving organisms do not pose a health threat?
3 N = 1 ? { ? \$? ? Food Preservation? ? ?B Aseptic packaging - ∟ Hot filling refers to product filling at elevated temperatures
up to 100 !, used to maintain sterility in products such as jams, syrups and juices Some products
can tolerate high temperatures for short time periods UHT processing of milk and fruit juices uses temperatures in the range of 135 to 150!, but for a few seconds or less. The high temperature is
enough to kill most pathogens. ?6 ?
UHT is the basis of most flexible aseptic drink packaging. The term aseptic as applied to packaging
refers to any system wherein the product and container are sterilized separately and then combined and
sealed under aseptic conditions. In the 1940s, metal cans were sterilized and filled with puddings,
sauces, and soups (the Dole Process). In the 1970s, aseptic packaging was adapted to institutional bag-
in-box systems Advantages: eliminating the need for the elevated temperatures and pressures used in
conventional canning methods; Eliminating the need for extreme sterilizing conditions allows aseptic
packaging materials to have lower physical strengths and lower temperature tolerance. ?D?
PG H ? &!?? Food Preservation? ?? - Commercial systems,
such as Tetra Pak, Combibloc, and Bosch, use hydrogen peroxide to sterilize simple paper, foil and
polyethylene laminates, and then fill the formed package with UHT-treated product Normal canning:
Only maintains nominal cleanliness in the food and the container, Subjected to temperatures (110 to
130 !) high enough to kill pathogens and achieve commercial sterility. ?&? P ?) Y ?

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? ? Food Preservation?
times needed to ensure destruction of Clostridium botulinum. Foods with acidities high enough to
prevent harmful pathogens from propagating can be heat-processed by immersion in boiling water.
                                     canned taste or texture. - The retortable pouch is a laminate of
Overcooking gives some foods their
polyester (for toughness), foil (for an oxygen barrier) and a heat-sealable polyolefin. Its largest
                           ?, i
                                       ? ( # ? ? Food Preservation? ?
customer is the military.?
Reduction - Drying is an old and well-established method of preserving food. - The essential feature of
drying is that moisture content is reduced below that required for the support of microorganisms. - An
added advantage is reduced bulk and reduction of other chemical activity. - Methods: by simple heat
drying or by the addition of salt or sugar. 00i.e., Concentrated salt and sugar solutions tie up free
water and make it unavailable to microorganisms. Jams and marmalades having high sugar contents do not
require refrigeration for this reason. ?4i
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                                                                          ? ) $ ? ? Food
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Preservation?
                          ?F - Equilibrium relative humidity (E.R.H) is the atmospheric humidity
condition under which a food will neither gain nor lose moisture to the air. - Aw, the water activity.
A food with an Aw of 0.5 is at an equilibrium relative humidity of 50%. Table 2.3 lists the moisture
                                                                 ? * % ? ? Food Preservation?
content and the desired E.R.H for some common foods.? G
                                                         G
             ??Table 2.3 Typical moisture content and E.R.H ranges OProduct 00000Typical Moisture(%)
E.R.H Potato chips, instant coffee0003% or less 000000010 to 20% Crackers, breakfast cereals0003 to 7%
00020 to 30% Cereal grains, nuts, dried fruit 007 to 20% 00030 to 60% Salt 0 0075% Sugar
00000000000000000 0085% ?RY
                                                      8
                                                     ?
                                                        ?? - Very low-E.R.H. foods are hygroscopic and
             ? + & ? ? Food Preservation?
will draw available moisture from the air. These foods require a barrier package that will not permit
the entry of atmospheric moisture. 1. Dried foods such as potato chips and instant coffee require
packaging materials with high moisture-barrier properties. Potato chips are also rich in oil (about
30%), so that they also need a high oxygen barrier. In-package desiccants and oxygen scavengers are
sometimes used to increase the shelf life of very sensitive products. 2. Dried foods with E.R.H. values
of 20 to 30% have less stringent moisture-barrier requirements and are easier to package. Depending on
the food, oxygen or other barriers may still be needed. ?0? P
                               3. Foods with an E.R.H. of 30 to 60% can often be stored for long
Preservation?
                          ?
periods with little or no barrier packaging since their E.R.H. corresponds to typical atmospheric
conditions. If the food has a high oil content, oxygen barriers may be needed. Bacteriological activity
is rarely a problem with low- or reduced-moisture foods since one of the essentials of bacterial growth
has been removed. 4. High E.R.H. foods lose moisture under typical atmospheric conditions. A cake with
an E.R.H. of 90% would soon establish a relative humidity of 90% inside a sealed package, creating
ideal conditions for mold growth. The packaging challenge is to control moisture loss, retarding it as
much as possible, but not to the extent that a high humidity is established within the package.?
                            ? ¬¬(¬?¹?◀Food Preservation?
&
                                                                         Chemical Preservatives -
Various natural and synthetic chemicals and antioxidants are used - They are used in conjunction with
other preservation methods. - The use of most of them is strictly controlled by law. - Chemical
                                                          ? . ) ? ? Food Preservation?
preservatives work in various ways: ?,
   ?1 1. Some, such as lactic, acetic, propionic, sorbic and benzoic acids, produce acid environments.
2. Others, such as alcohol, are specific bacteriostats. Carbon dioxide, found in beers and carbonated
beverages creates an acid environment and is also a bacteriostat. 3. Smoking and curing of meat and
fish is partly a drying process and partly chemical preservation. 4. Aliphatic and aromatic wood
distillation products (many related to creosote) are acidic and have variable bacteriostatic effects.
Varying amounts of salt pretreatment accompanies most smoking. 5. Antioxidants and oxygen absorbers can
                                            Y
                                                           ? / * ? ? Food Preservation?
                        Pm
                                ?b
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reduce oxidation.? m
   ??Modified Atmosphere Packaging - MAP recognizes that many food degradation processes have a
relationship with the surrounding atmosphere. - MAP involves the introduction of a gas mixture other
than air into a package - CAP is used in storage and warehousing where the atmosphere can be monitored
and adjusted. - Vacuum packaging is one type of MAP. It has the effect of eliminating some or all
oxygen that might contribute to degradation. ?.? Z
                                                                   ? 0 + ? ? Food Preservation?
                00Disadvantages: fruits and vegetables have respiratory functions that must be
continued; red meat will turn brown or purple without oxygen; pressures created by the external
atmosphere surrounding a vacuum-packaged product can physically crush delicate products or squeeze
water out of moist products. - Ambient air is about 20% oxygen and 80% nitrogen, with a trace of carbon
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                                       ?? 1 , ? ? Food Preservation?
                                                                                    ??0Table 2.4
dioxide. ?60
                   U
Typical modified atmospheres for selected food products OProduct 000xygen Carbon Dioxide Nitrogen ORed
meat 00040% 000020% 40% 0White meats/pasta ---- 000050% 50% 00Fish 20% 000080% ---- 0Produce 00005%
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??Generally, the less acid the food, the longer the cook

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0000---- 000095% OBaked goods 001% 0060% 39%?ZK
                                                                         ? 2 -¬?¹?∢Food
2
     В
                           - 02 is biologically active, and for
Preservation?
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\frac{1}{1}, \frac{1}{1}, 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
 most
products, is associated with respiration and oxidation. - Co2 in high concentrations is a natural
bacteriostat. Levels of 20% and higher are used to create conditions unfavorable to most
microorganisms. - N2 is biologically inert,
                                            filler gas or to displace oxygen. - Most packaging
materials used in MAP for everything other than produce must have good gas-barrier properties to all
three gases. ??
                                     ?a
  & ? 3 . ? ? Food Preservation?
                                               ? - A package containing only carbon dioxide and
nitrogen is a system where atmospheric oxygen is trying to penetrate the package and establish an
equilibrium partial pressure. The integrity of all seals is of paramount importance. - The natural
respiration of a fruit or vegetable consumes oxygen and produces carbon dioxide and moisture.
Ventilated or low-barrier packaging is needed to ensure a supply of oxygen and to rid the package of
excess moisture. - MAP has increased natural shelf life by 2 to 10 times. ?
                               ?$ Irradiation - Radiation is energy categorized by wavelength and
includes radio waves, microwaves, infrared radiation, visible light, ultraviolet light and X rays. -
These types of radiation increase in energy from radio to X rays; the shorter the wavelength, the
greater the energy. - Given sufficient energy, waves can penetrate substances. With more energy still,
they will interact with the molecules of the penetrated substance. - Short-wavelength radiations have
enough energy to cause energy to ionization of molecules, mainly water. ?H!
                    ? 5 0 ? ? Food Preservation?
                                                          ? ?N - Ionization can disrupt complex
molecules and leads to the death of living organisms. - Irradiation has been used to increase the
keeping quality of various foods. Cobalt 60, a radioactive isotope, is the principal source of ionizing
radiation (gamma rays). - All safety precautions pertaining to radioactive hazards must be observed. It
should be noted that while the energy source is radioactive, gamma rays cannot make other substances
radioactive. - Irradiation is a unique process in that it is carried out at ambient temperatures and
can penetrate packaging material or products.? 0
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  ? - Irradiation of consumable food is an issue that is not fully resolved, and the process is
carefully controlled in most countries. - Food irradiation is prohibited in some countries and highly
regulated in most. However, the use of irradiation to achieve sterility for medical devices, packaging
materials and personal care products does not present a problem and is a useful technology. - Labeling
is another contentious issue. The irradiation symbol must be accompanied by a statement such as
                                                   Р
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                                                                 2 ? ? Food Preservation?
treated by irradiation
                       or
                             irradiated . ?
       ? 8 3 ? ? The Transport Function?
                                                   ?
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                                                           The transport function and examples of
transport modes - The transport function entails the effective movement of goods from the point of
production to the point of final consumption. - This involves various transport modes, handling
techniques and storage conditions. - In addition to the general physical rigors of distribution, there
are a number of carrier rules that will influence package design. Examples of some of the information
required to design successful distribution packaging appear in Table 2.5. ?0
 9 4 ? ? The Transport Function?
                                          ? ?? Table 2.5 Typical transport handling and storage
information truck rail aircraft cargo ship storage duration storage conditions handling methods
unitizing methods specific shipping unit weight considerations stock-picking dimension limits carrier
                                                                 ? : 5 ? ? The Transport Function?
rules environmentally controlled storage?6?
                                                            Z
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            ?{ - Transportation and distribution is generally regarded as an activity that is
hazardous to the product being moved. - Packaging contributes to the safe, economical, and efficient
storage of a product. Good package design take into account the implications of transport and
warehousing, not just for the distribution package and unitized load, but for every level of
                             { ? < 7 ? ? The Transport Function?
                                                                           ?
                                                                               ?F 2.
good package is said to have a persona , or personality. If the designer has done an effective job,
that persona will appeal to the targeted audience. - The targeted audience itself needs to be
identified and studied. This is the realm of demographics and psychographics. ?H
                 ?; 6 ? ? The Inform/Sell Function ?
                                                                      ??1. Package communication
roles - The communication role of packaging is perhaps the most complex of the packaging functions to
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understand, measure and implement because of the many levels at which this communication must work. Law or customs dictate certain messages without much leeway in their presentation. Examples of such message are: 佛 Specific name of the product (what is this?) 佛 Quantity contained 佛 Address of the Z responsible body? Z8 Z & ? ?H 3. How a package communicates 佛 Selected = 8 ? ? The Inform/Sell Function ? material 佛 Shape and size 佛 Color 佛 Predominant typography 佛 Recognizable symbols or icons 佛 Illustrations? Inform/Sell Function? & ? x - All of the communication channels must be balanced and supportive of one another to produce a persona with appeal and instant recognition. - All supporting material, such as promotions and advertisements, must agree with the image projected by the package. -Producing a well-balanced package persona requires an intimate familiarity with not just the structural qualities of packaging materials, but also the emotional qualities that they project. - A thorough understanding of the various printing processes and the specialized decorating techniques used to create particular effects or decorate unusual surfaces is essential.? y Py ? ?0 €€₩ ?^? ? ≧;u ?>../jiaoxueluxiang/flash/2-1.EXE ??/? 0? ???DAriallac甫!!甫!!(+8? ? ?0 8?z[00? ?D媒SOal !? #\$%&' ()*+, -. /0123456789:; <=>?@B?

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□+, D 胀諟.←+摋□+, X
  B Arial 宋体+Times New Roman ensors located in our nasal passages What we perceive as a food
product s flavor is a combination of what we detect with our sense of taste combined with what we
detect with our sense of smell. Preservation of essential oils retains the food
                                                            s full flavor at
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retail.?
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Preservation?
                      Essential oils are volatile. Volatiles can permeate packaging materials
and making the problem of contamination or isolation even more difficult. Water vapor is similar to an
essential oil in that it readily permeates many packaging materials. The creation of high-barrier
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packaging systems is partly in response to the need for packaging that will either hold desirable gases and volatiles in the package or prevent undesirable volatiles from entering the package. Temperature

can promote undesirable changes that are abiotic in nature. ? Food Preservation? ??Meat products - Meats are an ideal medium for microorganisms because they contain all the necessary nutrients to sustain growth. In addition to biological action, fatty tissue is susceptible to oxidation, and the entire mass can lose water. - Reduced temperature retards microorganism activity, slows evaporation and slows chemical reactions such as those associated with ? ? ? Food Preservation? x @ < ? ??Fish - The preservation of fish is a difficult challenge because of three main factors: 佛 Psychrophilic bacteria may be present. 佛 Many fish oils are unsaturated and are easily oxidized. 佛 Typical fish proteins are not as stable as red meat proteins. - Chilling does not affect the activity of psychrophilic bacteria. Frozen fish is typically kept at much lower temperatures (-300C/) than other frozen foods in order to ensure the control of psychrophilic bacteria.?X Z Z ZΖ ? ??Produce - Harvested fruits and ? ? Food Preservation? vegetables continue to respire and mature. - They contain large amounts of water and will wither if water loss is excessive. - Peas, green beans, and leafy vegetables have high respiration rates compared with those of apples oranges, and pears. - Potatoes, turnips and pumpkins respire slowly and are easy

to store, moisture ross is more rapid with rettuce than with a turnip because of the rarge available
surface area. ?. Z? Z ? ? Pood Preservation? ? ?? - Most fruits have an
optimum ripening temperature, usually about 200C. Few fruits will ripen below 50C Freezing of many
produce items will damage cell structure, and breakdown is very rapid after thawing Modified
atmosphere packaging used(CO2, O2) - Bananas can remain in a mature but green state for up to six
months in atmospheres of 92% nitrogen, 5% oxygen, 3% carbon dioxide and no ethylene. ?X?
P P ? ? Prood Preservation? ? ?v - Atmosphere and
temperature control are key requirements for extending the shelf life of fresh produce. Trade-offs for
many produce items: 90%RH+perforated plastic wrap; or Selecting packaging films with high gas-
transmission rates. i.e. precut salad bags (the shelf life of about ten days): excellent moisture
barrier and very low oxygen barrier. ?6j P Pw ? Y? ? Food
Preservation? ? ? Barrier Packaging ?2 ? ? ? Food
Preservation? ? ?c - Stopping the movement of a gas requires barrier packaging This
packaging construction either retains desirable gases and volatiles inside the package or prevents
undesirable gases and volatiles from entering the package Of the materials a packager can choose
from, only glass and metal provide absolute barriers to all gases and volatiles. ?
6b a ? c ? ? Food Preservation? ? ??— The term "high
barrier" plastic is a relative, nonspecific term and should not be taken to mean "absolute" barrier
Barrier packaging can harm some products. Fresh produce, for example, continues to respire after
harvesting and would shortly consume all the oxygen in an oxygen-barrier package. This would lead to
reduced shelf life. Plastic bags for produce commonly have vent holes punched in them to allow for a
free exchange of atmospheric gases. ?\$? P P? ? ? Food Preservation? ? ?N 3.
Microorganisms and their preferred environments for propagation Microorganisms - A large part of food
preservation depends on the control of microorganisms Bacteria or microbes are unicellular
microscopic organisms that reproduce by binary fission Certain bacterial species can form spores
that are highly resistant to killing Molds or fungi are multicellular and unicellular plantlike
organisms Yeasts are similar organisms that reproduce by budding. The propagation and spread of
molds and yeasts is typically slower than for bacteria because of the reproduction method.?
TC P P? PC ? ? h ? ? ? Food Preservation? ? ?
N Microorganisms preferred environments for propagation - By manipulating the four principal
environmental factors that regulate microorganism growth, microorganisms can be controlled or
eliminated: temperature moisture acidity (pH) nutrient source?H b 6 ? ?
? Food Preservation? ? ?? Microorganisms are often classified by their preferred
reproduction environment: Mesophyllic: Prefer ambient conditions, 20-450C Psychrophilic: Prefer cool
conditions, 10-250C Thermophilic: tolerate heat; will propagate at 30 to 750C Aerobic: need oxygen to
propagate Anaerobic: propagate only in the absence of oxygen ?S S "
,
Some microorganisms act only on the food. They do little harm when ingested - Pathogenic organisms can
cause sickness or death, falling into basic classes: 佛 Those that produce harmful toxins as by-
products in the food they infest. MR Those that infest the food and then grow in the human body to
produce illnesses.?j
?X 4. Six basic methods, which are used alone or in combination, can extend the normal biological
shelf life of food: 佛 Reduced temperatures 佛 Thermal processing 佛 Water reduction 佛 Chemical
preservation 佛 Modified atmospheres 佛 Irradiation — Each method can slow the natural biological
maturation and spoilage of a food product, reduce biological activity or inhibit the chemical activity
that leads to abiotic spoilage Each method requires its own unique blend of packaging materials and
technology. ?% P Pr
" ? ? ??
Food Preservation? ? ?@ Reduced Temperature and Freezing - Reducing temperatures below the
ambient temperature has many beneficial effects that will lead to a longer shelf life. Doing so 佛
Slows chemical activity 佛 Slows loss of volatiles 佛 Reduces or stops biological activity - Bacteria
and molds stop developing at about -80C, and by -180C, chemical and microorganism activity stops for
most practical purposes. ? n & ?
? ? Food Preservation? ? ? - Freezing kills some microorganisms, but not to the extent
of commercial usefulness Ice crystal formation is greatest between 0 and -5!. Ice crystals can
pierce cell walls, destroying the texture of many fruits and vegetables. Rapid freezing reduces this

damage. - Freezer conditions will cause ice to sublimate, and serious food dehydration(freezer burn) will occur. Snug, good moisture-barrier packaging with a minimum of free air space will reduce freezer

? ?? - Frozen food packages materials must remain flexible at ? ? Food Preservation? freezer temperatures, provide a good moisture barrier and conform closely to the product. - When paperboard is used as part of the package, it should be heavily waxed or coated with polyethylene to give protection against the inevitable moisture present in the freezing process. - Poultry packaging in high-barrier PVDC bags is an excellent example of an ideal freezer pack. Prepared birds, placed into bags, pass through a vacuum machine that draws the bag around the bird like a second skin. The tight barrier prevents water loss and freezer burn for extended periods, as well as preventing passage of ?? " oxygen that would oxidize fats and oils.? ? P? ? ? ? Food Preservation? N Thermal Processing - Heat can destroy microorganisms. The degree of treatment depends on the: 佛 Nature of the microorganism to be destroyed 佛 Acidity (pH) of the food 佛 Physical nature of the food 佛 Heat tolerance of the food 佛 Container type and dimensions? ?? - Pasteurization, a mild heat treatment of 60 to 700C, kill most, but not Preservation? all, microorganisms present. Pasteurization is used when 佛 More severe heating would harm the product 佛 Dangerous organisms are not very heat resistant (such as some yeasts) 佛 Surviving organisms can be controlled by other means 佛 Surviving organisms do not pose a health threat? 1 ? { ? \$? ? Food Preservation? ?B Aseptic packaging - ∟ Hot filling refers to product filling at elevated temperatures up to 100 !, used to maintain sterility in products such as jams, syrups and juices. - Some products can tolerate high temperatures for short time periods. - UHT processing of milk and fruit juices uses temperatures in the range of 135 to 150!, but for a few seconds or less. The high temperature is ? % ? ? Food Preservation? enough to kill most pathogens. ?6 ? ? UHT is the basis of most flexible aseptic drink packaging. The term aseptic as applied to packaging refers to any system wherein the product and container are sterilized separately and then combined and sealed under aseptic conditions. In the 1940s, metal cans were sterilized and filled with puddings, sauces, and soups (the Dole Process). In the 1970s, aseptic packaging was adapted to institutional bagin-box systems. - Advantages: eliminating the need for the elevated temperatures and pressures used in conventional canning methods; Eliminating the need for extreme sterilizing conditions allows aseptic packaging materials to have lower physical strengths and lower temperature tolerance. ?D? ? & ! ? ? Food Preservation? such as Tetra Pak, Combibloc, and Bosch, use hydrogen peroxide to sterilize simple paper, foil and polyethylene laminates, and then fill the formed package with UHT-treated product. - Normal canning: Only maintains nominal cleanliness in the food and the container, Subjected to temperatures (110 to 130 !) high enough to kill pathogens and achieve commercial sterility. ?&? "? ? Food Preservation? ? ??Generally, the less acid the food, the longer the cook times needed to ensure destruction of Clostridium botulinum. Foods with acidities high enough to prevent harmful pathogens from propagating can be heat-processed by immersion in boiling water. Overcooking gives some foods their canned taste or texture. - The retortable pouch is a laminate of polyester (for toughness), foil (for an oxygen barrier) and a heat-sealable polyolefin. Its largest customer is the military.? ?, i ? (# ? ? Food Preservation? Reduction - Drying is an old and well-established method of preserving food. - The essential feature of drying is that moisture content is reduced below that required for the support of microorganisms. - An added advantage is reduced bulk and reduction of other chemical activity. - Methods: by simple heat drying or by the addition of salt or sugar. 00i.e., Concentrated salt and sugar solutions tie up free water and make it unavailable to microorganisms. Jams and marmalades having high sugar contents do not require refrigeration for this reason. ?4i Р Р ? i ?) \$? ? Food Preservation? ? ?F - Equilibrium relative humidity (E.R.H) is the atmospheric humidity condition under which a food will neither gain nor lose moisture to the air. - Aw, the water activity. A food with an Aw of 0.5 is at an equilibrium relative humidity of 50%. Table 2.3 lists the moisture content and the desired E.R.H for some common foods.? G G ? * % ? ? Food Preservation? ??Table 2.3 Typical moisture content and E.R.H ranges OProduct 00000Typical Moisture(%) E.R.H Potato chips, instant coffee0003% or less 000000010 to 20% Crackers, breakfast cereals0003 to 7% 00020 to 30% Cereal grains, nuts, dried fruit 007 to 20% 00030 to 60% Salt 0 0075% Sugar 00000000000000000 0085% ?RY ? ? + & ? ? Food Preservation? ?? - Very low-E. R. H. foods are hygroscopic and will draw available moisture from the air. These foods require a barrier package that will not permit

the entry of atmospheric moisture. 1. Dried foods such as potato chips and instant coffee require

dehydration. Complete filling of the package is desirable. ?F

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& ? 3 . ? ? Food Preservation?

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useful technology. - Labeling is another contentious issue. The irradiation symbol must be accompanied
by a statement such as
                        treated by irradiation or irradiated . ?
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for every level of packaging.? \ \ ? \ \ ? \ \ ? \ ? \ ? The Transport Function?
       Persona - A good package is said to have a persona , or personality. If the designer has
done an effective job, that persona will appeal to the targeted audience. - The targeted audience
itself needs to be identified and studied. This is the realm of demographics and psychographics. ?H
                            ?; 6 ?? The Inform/Sell Function?
                                                                          & ?
communication roles - The communication role of packaging is perhaps the most complex of the packaging
functions to understand, measure and implement because of the many levels at which this communication
must work. - Law or customs dictate certain messages without much leeway in their presentation.
Examples of such message are: 佛 Specific name of the product (what is this?) 佛 Quantity contained 佛
Address of the responsible body?
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                             & ?
Inform/Sell Function?
                                    ?H 3. How a package communicates 佛 Selected material 佛 Shape
and size 佛 Color 佛 Predominant typography 佛 Recognizable symbols or icons 佛 Illustrations?
                                                                   ? > 9 ? The Inform/Sell
Function ?
                        ?x - All of the communication channels must be balanced and supportive of one
another to produce a persona with appeal and instant recognition. - All supporting material, such as
promotions and advertisements, must agree with the image projected by the package. - Producing a well-
balanced package persona requires an intimate familiarity with not just the structural qualities of
packaging materials, but also the emotional qualities that they project. - A thorough understanding of
the various printing processes and the specialized decorating techniques used to create particular
effects or decorate unusual surfaces is essential.? y
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       饒?」」?VFigure 2.1 Packaging can have many levels. All levels of the system must work together?
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